Botulinum Toxin Type A (BoNT/A), the Mandibular Neuromuscular Envelope, and Bite Jumping Appliances: Skeletal Effects

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I, Shari Jane Daniels confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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ABSTRACT

Background: Bite jumping appliances (BJA) are a common treatment modality for Class II malocclusions and yet studies have shown that the results are limited to mostly dentoalveolar correction. A better understanding of the role the muscles of mastication play in the action of these appliances is warranted. Botulinum neurotoxin type A (BoNT/A) is a useful research tool to decrease muscle function without impeding blood supply or causing scarring.

Objectives: BoNT/A was used in this study in combination with BJA to assess cephalometrically the effects that muscular stretch have on the skeletal outcomes of bite jumping therapy.

Methods*:* One hundred and twenty-eight inbred, juvenile, male, Wistar Kyoto (WKY) rats were randomly assigned to either: one of six short-term groups, or one of ten long-term groups (n = 8 per group). The short-term groups consisted of C (control), S (saline injection), B (BoNT/A injection), M (BJA), MB (BoNT/A injections plus BJA), MS (saline injection plus BJA). The long-term groups consisted of CL (control), BL (BoNT/A injection), BLR (BoNT/A repeat injection), SL (saline injection), SLR (saline repeat injection), ML (BJA), MBL (BoNT/A plus BJA), MBLR (BoNT/A repeat injection plus BJA), MSL (saline injection plus BJA), and MSLR (saline repeat injection plus BJA). In the BoNT/A injection groups the temporalis and deep masseter muscles were injected bilaterally with Dysport®. Equivalent volumes of saline were used within the sham injection groups. In the repeat injection groups, the injections were repeated weekly for the duration of the study. Digital lateral and dorsoventral cephalometric radiographs were taken at baseline (T0 = 28 days old) and weekly thereafter for 3 weeks until T3 (49 days of age) at which time the short-term groups were culled and all appliances removed. Additional radiographs were taken in the long-term groups at T4 (56 days of age), T5 (70 days of age), T6 (98 days of age), and T7 (126 days of age). The cephalometric program Viewbox 3.1® was used to create cephalometric analyses and obtain linear and angular measurements. After an initial repeatability study the variables were restricted to those deemed more accurate. Multiple comparisons between and within groups were conducted using one-way ANOVA with post-hoc test Tamhane.

Results: Importantly, the total mandibular length (Co↔Dg) and horizontal projection of the mandible were increased in the MBL and MBLR groups. The condyles also maintained a more anterior position in the MBL and MBLR groups.

Conclusions: The length of the mandible was only slightly affected in the experimental groups. The mandibular condyle and glenoid fossa of the rat does possess some adaptive capacity to altered extrinsic forces.

IMPACT STATEMENT

A Class II malocclusion is present in 20% of the entire population; many of these patients possess an underlying skeletal discrepancy. To date, studies agree that the treatment of these patients is achieved mostly via dentoalveolar correction, leaving orthognathic surgery (with associated morbidity and mortality) at the conclusion of growth as the only viable treatment option for severe cases. The question, 'can we grow mandibles beyond that which is genetically predetermined?' cannot truly be answered until all components affecting growth and therapy, including the effect of altering the function of the mandibular musculature during treatment, are understood. It would appear that there are some discrepancies within the animal literature as to whether additional mandibular growth and/or glenoid fossa remodelling is consistently achieved with bite jumping appliances, and most importantly, whether observed changes actually lead to increased mandibular sagittal projection. Few studies support both histological data with skeletal findings as a finding in one medium may not be reflected in the other. Essentially, the ultimate aim of bite-jumping therapy is to achieve a more anterior sagittal position of the mandible, relative to the maxilla; whether this is achieved by additional condylar or mandibular length (a goal chased extensively in the history of literature), or a more anterior position of the glenoid fossa, or a combination of both. To the author's knowledge, no radiographic studies exist using the rodent model whereby the position of the mandible relative to the cranial base and upper jaw is examined, as most focus solely on the length of the mandible and/or condyle. Further, no studies exist altering the effects of the masseter and temporalis muscles (the superficial mandibular muscles that are stretched) during bite jumping therapy. This long-term study using a rodent model aimed to examine the effects that reducing the stretch reflex induced in the temporalis and masseter muscles during bite jumping treatment to test an entirely original theory on the modality of these appliances in the hopes of adding valuable findings and understanding to the orthodontic literature from which further studies can be designed.

Table of Contents

1 LITERATURE REVIEW 14

1.1 Background and Significance 14

1.2 Muscles of Mastication and Mandibular Growth 14

1.3 Class II Malocclusion 14

1.3.1 Definition 14

1.3.2 The Burden and Blessing of Growth 15

1.3.3 Bite Jumping Appliances 16

1.3.4 Fixed or Removable Bite Jumping Appliances 17

1.3.5 Human Studies and Differential Sagittal Correction of the Maxilla and Mandible . 18

1.3.6 Timing of Treatment 19

1.3.7 Animal Studies 20

1.4 Biomechanical Theory of Bite Jumping Appliances 21

1.5 A New Biomechanical Theory for Bite Jumping Appliances 25

1.5.1 The Myotatic Biomechanical Theory of Bite Jumping Appliances 26

1.6 Botulinum Neurotoxin Type A (BoNT/A) 26

1.6.1 Introduction 26

1.6.2 BoNT/A Mode of Action 27

1.6.3 Botulinum Neurotoxin Use 29

1.6.4 Commercially Available Products 29

1.7 Releasing the Mandibular Neuromuscular Envelope with BoNT/A 30

1.8 Summary of Literature Review 30

2 DEVELOPING THE RESEARCH PROJECT 31

2.1 Objective 31

2.2 Aims 31

2.3 Null Hypothesis 31

2.4 The Experimental Design 31

2.4.1 Rodent In Vivo Experiments 31

2.4.2 Pilot Work 31

2.4.3 Sample Selection 31

2.4.4 Muscles Targeted 32

2.4.5 BoNT/A Doses, Onset, and Duration 34

2.4.6 Appliance Design 35

2.4.7 Cephalometric Analysis 37

3 MATERIALS AND METHODS 46

3.1 *In Vivo* Work to Obtain Samples 46

3.2 Radiography 50

3.4 Radiographic Measurement 52

3.5 Repeatability Study 52

3.6 Statistical Analysis for the Refined List of Variables 52
4 REPEATABILITY STUDY 53
4.1 Introduction 53
4.1.1 Errors of Cephalometric Tracing 53
4.1.2 Bland and Altman Diagrams 54
4.1.3 Lin's Concordance Correlation Coefficient 54
4.1.4 Paired t-test 54
4.1.5 British Standards Institution Repeatability Coefficient 54
4.2 Materials and Methods 55
4.3 Results 55
4.3.1 Lateral Cephalometric Repeatability 55
4.3.2 Lateral Cephalometric With Appliance Repeatability 60
4.3.3 Dorsoventral Cephalometric Radiographs Repeatability 62
4.4 Discussion for Repeatability Study 63
4.4.1 Lateral Cephalometric Repeatability Study 63
4.4.2 Dorsoventral Cephalometric Repeatability Study 64
4.5 Repeatability Study Outcomes 64
5 RESULTS 67
5.1 Weight of the Animals 67
5.1.1 Short-Term Groups Weight 67
5.1.2 Long-Term Groups Weight 70
5.2 Lateral Cephalometric Results 74
5.2.1 Short-Term Groups Lateral Cephalometric Results 74
5.2.2 Long-term Groups Lateral Cephalometric Results 92
5.3 Dorsoventral Cephalometric Results 180
5.3.1 Short-term Dorsoventral Cephalometric Results 180
5.3.2 Long-term Dorsoventral Cephalometric Results 193
6 DISCUSSION 252
6.1 Soft Diet Effects 252
6.2 Nutrition 252
6.3 Relative Skeletal Maturity 253
6.4 True Experimental Effects 254
6.4.1 Craniofacial Alterations as a Result of Bone Remodeling 254
6.4.2 Previous Bite Jumping Studies Involving Rodents 254
6.4.3 Lateral Cephalometric (LC) Measurements 255
6.4.4 Dorsoventral Cephalometric (DVC) Measurements 260
6.5 Considerations of the effects of BoNT/A 262
6.5.1 Diffusion and Doses 262
6.5.2 BoNT/A Effect on Bone 262

6.5.3 Clinical Safety of BoNT/A 263
6.5.4 The Complexity of BoNT/A as a Research Tool 264

7 CONCLUSIONS 264

8 REFERENCES 271

9 APPENDICES 286
9.1 Appendix 1: Pilot Work and Preliminary Studies 286
9.2 Appendix 2: Animal Ethics Certificate 287
9.3 Appendix 3: Bland and Altman (BA) Diagrams 288
9.3.1 BA Diagrams for Lateral Cephalometric (LC) Repeatability Study 288
9.3.2 BA Diagrams for Lateral Cephalometric With Appliances (LCWA) Repeatability Study 305
9.3.3 BA Diagrams for Dorsoventral Cephalometric (DVC) Repeatability Study 311
9.4 Appendix 4: Lateral Cephalometric (LC) Boxplots 320
9.4.1 LC-Short Term (ST) Boxplots 320
9.4.2 LC-Long-term (LT) Boxplots 325
9.5 Appendix 5: Dorsoventral Cephalometric (DVC) Boxplots 330
9.5.1 DVC-Short-term (ST) Boxplots 330
9.5.2 DVC-Long-term (LT) Boxplots 336

List of Figures

Figure 1: Direction of forces induced by the insertion of a Bite Jumping Appliance: 22
Figure 2: Voudouris's Theory of 'Growth Relativity': 24
Figure 3: Normal Neurotransmitter Release: 28
Figure 4: Snare Complex is Cleaved by BoNT/A: 28
Figure 5: Rodent Muscles of Mastication 33
Figure 6: Bite-jumping Appliance Design 37
Figure 7: Lateral Cephalometric Points: marked on a radiograph of a 28 day old male Wistar Kyoto rat 42
Figure 8: Dorsoventral Cephalometric Landmarks: marked on a radiograph of a 28 day old male Wistar Kyoto rat 45
Figure 9: Experimental Design 48
Figure 10: Injection Technique 49
Figure 11: Cephalometric Timepoints 51
Figure 12: Mean Weight (g) or the ST Groups at each timepoint T0 to T3 68
Figure 13: Boxplot of Weight (g) of the ST Groups at each timepoint T0 to T3 68
Figure 14: Mean Weight (g) of the Animals for the LT Groups at each timepoint T0 to T7 ... 71
Figure 15: Boxplot of Weight (g) of the LT Groups at each timepoint T0 to T7 72
Figure 16: Line Graph of Means of S↔Uii (mm) for LC-ST Groups from T0 to T3 77
Figure 17: Boxplot of S↔Uii (mm) for LC-ST Groups from T0 to T3 77
Figure 18: Line Graph of Mean Co↔Dg (mm) LC-ST groups from T0 to T3 79
Figure 19: Boxplot of Co↔Dg (mm) for the LC-ST Groups at T0 to T3 79
Figure 20: Line Graph of mean Ar↔Dg (mm) for the LC-ST Groups at T0 to T3 81
Figure 21: Boxplot of Ar↔Dg (mm) for the LC-ST Groups at T0 to T3 81
Figure 22: Line Graph of mean xCo (mm) for the LC-ST Groups at T0 to T3 83
Figure 23: Boxplot of xCo (mm) for the LC-ST Groups at T0 to T3 83
Figure 24: Line Graph of Mean xUii (mm) for LC-ST Groups from T0 to T3 85
Figure 25: Boxplot of xUii (mm) for LC-ST Groups from T0 to T3 85
Figure 26: Line Graph of Mean xLii (mm) for LC-ST Groups from T0 to T3 87
Figure 27: Boxplot of xLii (mm) for LC-ST Groups from T0 to T3 87
Figure 28: Line Graph of mean MPA (º) for LC-ST Groups from T0 to T3 89
Figure 29: Boxplot of MPA (º) for LC-ST Groups from T0 to T3 89
Figure 30: Line Graph of mean AoO (º) for LC-ST Groups from T0 to T3 91
Figure 31: Boxplot of AoO (º) for LC-ST Groups from T0 to T3 91
Figure 32: Line Graph of Means of S↔Uii (mm) for LC-LT Groups from T0 to T7 101
Figure 33: Boxplot of S↔Uii (mm) for LC-LT Groups from T0 to T7 102
Figure 34: Line Graph of mean Go↔Ag (mm) for LC-LT Groups from T0 to T7 108
Figure 35: Boxplot of Go↔Ag (mm) for LC-LT Groups from T0 to T7 109
Figure 36: Line Graph of mean Go↔Lii (mm) for LC-LT Groups from T0 to T7 115
Figure 37: Boxplot of Go↔Lii (mm) for LC-LT Groups from T0 to T7 116

Figure 38: Line Graph of Mean Co↔Dg (mm) LC-LT groups from To to T7 122
Figure 39: Boxplot of Co↔Dg (mm) LC-LT groups from T0 to T7 123
Figure 40: Line Graph of Mean Ar↔Dg (mm) for LC-LT groups from T0 to T7 129
Figure 41: Boxplot of Ar↔Dg (mm) for LC-LT groups from T0 to T7 130
Figure 42: Line Graph of Mean xCo (mm) for LC-LT groups from T0 to T7 136
Figure 43: Boxplot of xCo (mm) for LC-LT groups from T0 to T7 137
Figure 44: Line Graph of mean Co↔Mn (mm) for LC-LT Groups from T0 to T7 143
Figure 45: Boxplot of Co↔Mn (mm) for LC-LT Groups from T0 to T7 144
Figure 46: Line Graph of mean xUii (mm) for LC-LT Groups from T0 to T7 150
Figure 47: Boxplot of xUii (mm) for LC-LT Groups from T0 to T7 151
Figure 48: Line Graph of mean xLis (mm) for LC-LT groups from T0 to T7 157
Figure 49: Boxplot of xLis (mm) for LC-LT groups from T0 to T7 158
Figure 50: Line Graph of mean ADO1 (mm) for LC-LT Groups from T0 to T7 164
Figure 51: Boxplot ADO1 for LC-LT Groups from T0 to T7 165
Figure 52: Line Graph of mean MPA (º) for DVC-LT Groups from T0 to T7 171
Figure 53: Line Graph of MPA (º) for DVC-LT Groups from T0 to T7 172
Figure 54: Line Graph of mean AoO (º) for LC-LT Groups from T0 to T7 178
Figure 55: Boxplot AoO (º) for LC-LT Groups from T0 to T7 179
Figure 56: Mean lengths (mm) of xGo1 for DVC-ST groups at timepoints T0 to T3 183
Figure 57: Mean lengths (mm) of xGo2 for DVC-ST groups at timepoints T0 to T3 184
Figure 58: Boxplot of xGo1 (mm) for DVC-ST groups at timepoints T0 to T3 184
Figure 59: Boxplot of xGo2 (mm) for DVC-ST groups at timepoints T0 to T3 185
Figure 60: Mean lengths (mm) of xCd1 for DVC-ST groups at timepoints T0 to T3 187
Figure 61: Mean lengths (mm) of xCd2 for DVC-ST groups at timepoints T0 to T3 187
Figure 62: Boxplot of xCd1 (mm) for DVC-ST groups at timepoints T0 to T3 188
Figure 63: Boxplot of xCd2 (mm) for DVC-ST groups at timepoints T0 to T3 188
Figure 64: Mean lengths (mm) of Go1↔Go2 for DVC-ST groups at timepoints T0 to T7 .. 190
Figure 65: Boxplot (mm) of Go1↔Go2 for DVC-ST groups at timepoints T0 to T3 190
Figure 66: Line graph of Cd1↔Cd2 (mm) for DVC-ST groups at timepoints T0 to T3 192
Figure 67: Boxplot of Cd1↔Cd2 (mm) for DVC-ST groups at timepoints T0 to T3 192
Figure 68: Line graph of xGo1 (mm) for DVC-LT groups at timepoints T0 to T7 207
Figure 69: Line graph of xGo2 (mm) for DVC-LT groups at timepoints T0 to T7 208
Figure 70: Boxplot of xGo1 (mm) for DVC-LT groups at timepoints T0 to T7 209
Figure 71: Boxplot of xGo2 (mm) for DVC-LT groups at timepoints T0 to T7 210
Figure 72: Line graph of mean lengths of xCd1 (mm) for DVC-LT groups at timepoints T0 to T7 220
Figure 73: Line graph of mean lengths of xCd2 (mm) for DVC-LT groups at timepoints T0 to T7 221
Figure 74: Boxplot of xCd1 (mm) for DVC-LT groups at timepoints T0 to T7..................... 222
Figure 75: Boxplot of xCd2 (mm) for DVC-LT groups at timepoints T0 to T7..................... 223

Figure 76: Line graph of mean lengths of Go1↔Go2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 229
Figure 77: Boxplot of Go1↔Go2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 230
Figure 78: Line graph of mean lengths of Cd1↔Cd2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 236
Figure 79: Boxplot of Cd1↔Cd2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 237
Figure 80: Line graph of mean lengths of Zp1↔Zp2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 243
Figure 81: Boxplot of Zp1↔Zp2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 244
Figure 82: Line graph of mean lengths of Za1↔Za2 (mm) for DVC-LT groups at timepoints T0 to T7 ... 250
Figure 83: Boxplot of Za1↔Za2 (mm) DVC-LT groups at timepoints T0 to T7 ... 251
Figure 84: Boxplot of OSL (mm) LC-ST groups at timepoints T0 to T3 ... 320
Figure 85: Boxplot of BSL (mm) LC-ST groups at timepoints T0 to T3 ... 320
Figure 86: Boxplot of Go to Ag (mm) for the LC-ST Group at T0 to T3 ... 321
Figure 87: Boxplot of Go to Lii (mm) for the LC-ST Group at T0 to T3 ... 321
Figure 88: Boxplot of Co to Mn (mm) LC-ST groups at timepoints T0 to T3 ... 322
Figure 89: Boxplot of yCo (mm) LC-ST groups at timepoints T0 to T3 ... 322
Figure 90: Boxplot of ADO1 (mm) LC-ST groups at timepoints T0 to T3 ... 323
Figure 91: Boxplot of PPA (°) LC-ST groups at timepoints T0 to T3 ... 323
Figure 92: Boxplot of Radius f(mm) LC-ST groups at timepoints T0 to T ... 324
Figure 93: Boxplot of OSL (mm) LC-LT groups at timepoints T0 to T7 ... 325
Figure 94: Boxplot of BSL (mm) LC-LT groups at timepoints T0 to T7 ... 326
Figure 95: Boxplot of yCo (mm) LC-LT groups at timepoints T0 to T7 ... 327
Figure 96: Boxplot of PPA (º) for DVC-LT Group from T0 to T7 ... 328
Figure 97: Boxplot of Radius (mm) for DVC-LT Group from T0 to T7 ... 329
Figure 98: Boxplot of O↔N (mm) for DVC-ST groups at timepoints T0 to T3 ... 330
Figure 99: Boxplots of CBL (mm) for DVC-ST groups at timepoints T0 to T3 ... 330
Figure 100: Boxplot of Zp1↔Za1 (mm) for DVC-ST groups at timepoints T0 to T3 ... 331
Figure 101: Boxplot of Zp2↔Za2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 331
Figure 102: Boxplot of xMx1 (mm) for DVC-ST groups at timepoints T0 to T3 ... 332
Figure 103: Boxplot of xMx2 (mm) for DVC-ST groups at timepoints T0 to T7 ... 332
Figure 104: Mean lengths of C1↔C2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 333
Figure 105: Mean lengths of Zp1↔Zp2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 333
Figure 106: Boxplot of P1↔P2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 334
Figure 107: Boxplot of Za1↔Za2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 334
Figure 108: Boxplot of Mx1↔Mx2 (mm) for DVC-ST groups at timepoints T0 to T3 ... 335
Figure 109: Boxplot of O↔N (mm) for DVC-LT groups at timepoints T0 to T7 ... 336
Figure 110: Boxplot of CBL (mm) for DVC-LT groups at timepoints T0 to T7 ... 337
Figure 111: Boxplot of Zp1↔Za1 (mm) for DVC-LT groups at timepoints T0 to T7 ... 338

Figure 112: Boxplot of Zp2↔Za2 (mm) for DVC-LT groups at timepoints T0 to T7 339
Figure 113: Boxplot of xMx1 (mm) for DVC-LT groups at timepoints T0 to T7 340
Figure 114: Boxplot of xMx2 (mm) for DVC-LT groups at timepoints T0 to T7 341
Figure 115: Boxplot of C1↔C2 (mm) DVC-LT groups at timepoints T0 to T7 342
Figure 116: Boxplot of P1↔P2 (mm) DVC-LT groups at timepoints T0 to T7.................... 343
Figure 117: Boxplot of Mx1↔Mx2 (mm) DVC-LT groups at timepoints T0 to T7............... 344

List of Tables

Table I: Definitions of Lateral Cephalometric Points 39
Table II: Definitions of Variables Measured 40
Table III: Definitions of Dorsoventral Cephalometric Landmarks.. 43
Table IV: Definitions of Dorsoventral Variables Measured 44
Table V: Experimental Key... 47
Table VI: Lateral Cephalometric Repeatability Results 56
Table VII: Results of Repeatability Study for Lateral Cephalometric Radiographs taken with Mandibular Appliances in place 60
Table VIII: Dorsoventral Cephalometric Repeatability Results 62
Table IX: Refined Lateral Cephalometric Variables 65
Table X: Refined Dorsoventral Cephalometric Variables 66
Table XI: Weight (W) of the Animals for the ST Groups at each time point (T) 67
Table XII: Weight (W) of the Animals for the LT Groups at each time point (T) 70
Table XIII: Means and Standard Deviations for the LC-ST Groups...................................... 74
Table XIV: Multiple Comparisons Within Groups LC-ST for S to Uii 76
Table XV: Multiple Comparisons Within Groups LC-ST for Co↔Dg 78
Table XVI: Multiple Comparisons Within Groups LC-ST for Ar↔Dg 80
Table XVII: Multiple Comparisons Within Groups LC-ST for xCo.. 82
Table XVIII: Multiple Comparisons Within Groups LC-ST for xUii 84
Table XIX: Multiple Comparisons Within Groups LC-ST for xLis... 86
Table XX: Multiple Comparisons Within Groups LC-ST for MPA 88
Table XXI: Multiple Comparisons Within Groups LC-ST AoO 90
Table XXII: Means and Standard Deviations for the LC-LT Groups.................................... 92
Table XXIII: Multiple Comparisons Within Groups LC-LT for S to Uii.................................. 97
Table XXIV: Multiple Comparisons Within Groups LC-LT for Go to Ag.............................. 103
Table XXV: Multiple Comparisons Within Groups LC-LT for Go to Lii................................ 110
Table XXVIL: Multiple Comparisons Within Groups LC-LT Go to Lii.................................. 117
Table XXVII: Within Groups Multiple Comparisons LC-LT for Ar to Dg.............................. 124
Table XXVIII: Multiple Comparisons Within Groups LC-LT for xCo.................................... 131
Table XXIX: Multiple Comparisons Within Groups LC-LT for Co to Mn 138
Table XXX: Multiple Comparisons Within Groups LC-LT for xUii 145
Table XXXI: Within Comparisons LC-LT for xLis 152
Table XXXII: Multiple Comparisons Within Groups LC-LT for ADO1 159
Table XXXIII: Multiple Comparisons Within Groups LC-LT for MPA 166
Table XXXIV: Multiple Comparisons Within Groups LC-LT for AoO 173
Table XXXV: Means and Standard Deviations for the DVC-ST Groups 180
Table XXXVI: Multiple Comparisons Within Groups DVC-ST for xGo1 and xGo2.............. 182
Table XXXVII: Multiple Comparisons Within Groups for xCd1 and xCd2.......................... 185

Table XXXVIII: Multiple Comparisons Within Groups for Go1 to Go2 189
Table XXXIX: Multiple Comparisons Within Groups for Cd1 to Cd2 191
Table XL: Means and Standard Deviations for the DVC-LT Groups 193
Table XLI: Multiple Comparisons Within Groups DVC-LT xGo1 and xGo2........................ 199
Table XLII: Multiple Comparisons Within Groups DVC-LT for xCd1 and xCd2................... 211
Table XLIII: Multiple Comparisons Within Groups DVC-LT for Go1 to Go2 224
Table XLIV: Multiple Comparisons Within Groups DVC-LT for Cd1 to Cd2 231
Table XLV: Multiple Comparisons Within Groups for Zp1 to Zp2 238
Table XLVI: Multiple Comparisons Within Groups Za1 to Za2 245

1 LITERATURE REVIEW

1.1 Background and Significance

Today, our understanding of craniofacial growth and development remains largely theoretical. It is still unknown exactly 'how' or 'if' the muscles of mastication affect or potentially dictate growth of the mandible. This abyss in the knowledge further impacts upon orthodontic orthopaedic therapy. The exact response of the mandibular condyle, glenoid fossa, and mandibular muscles to bite-jumping appliances is consequently poorly understood (Hajjar et al., 2003). Botulinum neurotoxin type A (BoNT/A) is a highly lethal toxin that targets cholinergic motor nerve terminals causing local or systemic muscular paralysis. The desired clinical effect with BoNT/A injection in many instances is partial or total muscle paralysis. This occurs via inhibition of acetylcholine exocytosis at the neuromuscular junction (Aoki, 2005). More specifically to the craniofacial region, BoNT/A is commonly used to manage bruxism, masseteric hypertrophy, and blepharospasm. BoNT/A is also emerging as a useful tool to study craniofacial growth (Kwon et al., 2007, Matic et al., 2007, Tsai et al., 2009). This experimental use may be extrapolated to the study of craniofacial orthopaedic research. Of particular relevance to this area, BoNT/A is capable of blocking the muscle spindle stretch reflex and hence is a useful tool to study the effects of muscular stretch induced during appliance wear (Filippi et al., 1993).

1.2 Muscles of Mastication and Mandibular Growth

Of specific interest in the literature have been the effects of masticatory muscle structure and hence function on craniofacial skeletal morphology. Abnormal alterations in skeletal morphology have been observed in both experimentally induced and pathological conditions affecting the muscles of mastication (McNamara, 1973, Phillips et al., 1982, Kiliaridis et al., 1985, Kiliaridis et al., 1989, Kiliaridis, 1995). It is still definitively unknown whether genetics determining facial morphology also dictates the structure and strength of the mandibular muscles or whether the activity of the musculature assists in sculpting the face (Pepicelli et al., 2005). This unanswered question would seem in part to be due to there being several hindrances with regard to experimental techniques. Surgical resection of muscles will often result in both interference of the blood supply to the muscles and bony architecture and also in significant scarring which may interfere directly with the post-operative results (Boyd et al., 1966). If the blood supply could be maintained, as it is with BoNT/A paralysis, while reducing muscular tension, the true effects of the actions of the muscle on skeletal morphology could be assessed (Boyd et al., 1966).

1.3 Class II Malocclusion

1.3.1 Definition

Angle defined a Class II dental malocclusion to be present when the mesiobuccal cusp of the upper first molar lay more than one-half cusp width mesial to the buccal groove of the lower first molar (Angle, 1907). Although this classification is simple and has some shortcomings, it is still the most widely accepted (Snyder and Jerrold, 2007). The prevalence of Class II malocclusion is approximated from epidemiological studies to be about 20 per cent of the entire population (Bishara, 2001). A Class II dental malocclusion can occur in a patient with a normal Class I or Class II skeletal pattern. However, as the severity of the skeletal discrepancy increases, a coincident dental malocclusion becomes more likely (Freer, 1999). A patient with a skeletal Class II discrepancy will show a distal relationship of the mandibular basal bone to the maxillary basal bone (Freer, 1999). This in itself is further complicated by the relative sagittal positions of the maxilla and mandible to the anterior cranial base (sella-nasion) or to a given perpendicular projection of a cephalometric point such as nasion vertical to natural head position (Cooke, 1990, Arnett and Bergman, 1993, Freer, 1999). Examination of the horizontal and vertical relationships of the jaws to the cranial base will further reveal that there are a number of combinations of discrepancies as to which jaw (or both) is at fault (Moyers, 1980). The answer to Lyle Johnston's (1996) question relating to the sense behind treatment, *"do all Class II patients have a small mandible?"* is no (Johnston, 1996). The fault may lie with the maxilla, the mandible, both or be otherwise difficult to define. In saying this, a retrognathic mandible is commonly observed (Ngan et al., 1997, Bishara, 1998).

1.3.2 The Burden and Blessing of Growth

For the growing skeletal Class II patient, correction must come from *"differential growth horizontally between the maxilla and the mandible" (Burstone, 1997).* This differential sagittal change may be achieved by a) restraining the maxilla only, for example with the use of head-gear, b) protracting the mandible, or c) both (Williams and Melsen, 1982, Burstone, 1997). Remaining growth is the most important factor in implementing Class II therapy (Burstone, 1997). Proper vertical control, including avoidance of steepening the occlusal plane, is essential for successful Class II treatment, as good mandibular sagittal growth may be lost with downward and backward mandibular rotation (Burstone, 1997). Rotations are considered to have an important effect on the sagittal position of the mandible (Bjork, 1969). Patients who exhibit a posterior condylar rotation during treatment, and hence there is reduced condylar vertical growth compared with vertical maxillary development, tend to show a displacement of the pogonion (chin position) relative to the maxilla, enhancing the sagittal discrepancy. This highlights the importance of controlling the vertical development of the maxilla (Williams and Melsen, 1982).

It has been found that mandibular growth may generally be favourable as it grows in excess of the maxilla resulting on average in a straighter profile with time (Lande, 1952, Johnston, 1996). However, it is important to remember that prediction of this potentially favourable growth in the individual patient remains elusive (Bjork, 1969). This is not to suggest that a Class II dental malocclusion will self-correct, the interlocking of the teeth may prevent this from occurring (Johnston, 1996).

1.3.3 Bite Jumping Appliances

A bite jumping appliance is essentially a functional appliance. Traditionally, *"the term functional appliance refers to any appliance which utilises one or more of the groups of circum-oral and craniofacial muscles" (Freer, 1999).* Returning to growth again, Meikle presents a balanced view of the literature, and so it would seem that both intrinsic and extrinsic forces are involved in condylar growth (Meikle, 1973). Ultimately, these findings would indicate that there are two ways to target therapeutic applications aimed at modifying condylar growth: i) intrinsically, ii) extrinsically via altering the orofacial environment. The latter is the foundation that functional appliance therapy has been built on. The 'potential' adaptive role of the condyle and glenoid fossa is well documented and forms the crux of functional appliance therapy (McNamara and Carlson, 1979, Woodside et al., 1987, Johnston, 1996, Meikle, 2002).

An appliance that produces a force that leads to sustained mandibular protraction can be considered a 'bite jumping appliance'. However, for the present work, the author considers a 'bite jumping appliance' to be any appliance or mode of treatment which a) places a retractive force on the upper dentition and maxilla, b) places a protrusive force on the lower dentition and the mandible and c) causes separation of the interdigitation of the upper and lower dentition. Theoretically, any active intermaxillary appliance used in orthodontics may potentially have both dentoalveolar and orthopaedic effects. This includes removable appliances such as a Twin-block (Clark, 2010), fixed appliances such as the Herbst or Cantilever Bite Jumpers, or even heavy Class II elastics. Although the dental effects, soft tissue effects, and possibly the skeletal effects may vary with appliances, all essentially 'distract' the mandibular condyle away from the glenoid fossa while providing a backwards force to the maxilla. It is this distraction of the condyle away from the glenoid fossa that is of utmost interest to this work.

In many patients bite jumping appliances can achieve excellent *"spatial relationships of the upper and lower dental arches in carefully selected cases" (Freer, 1999).* Whether a true increase in mandibular sagittal position is achieved skeletally is heavily debated (Johnston, 1996). In addition, whether or not any differential change between the maxilla and mandible is due to true orthopaedic effect of an appliance, or to normal growth of an individual patient who grew favourably is also debatable (Burstone, 1997). Without the untreated identical twin, these questions remain.

The mode of action of functional appliances is still controversial (Collet, 2000). Considering that the majority of Class II skeletal patients display a retrognathic mandible, lengthening the mandible is of great therapeutic interest to the orthodontist (Ngan et al., 1997). Ultimately, the burning question remains, is it possible to inhibit maxillary growth and enhance mandibular growth beyond inherent potential? Further, are orthopedic changes lost if treatment and/or retention is not enforced until the slowing of growth (Burstone, 1997)? How do bite jumping appliances work? Johnston's statement, *"there really is nothing in the oft-quoted, but rarely understood, works of Moss or Petrovic from which one can synthesize an answer"* (Johnston, 1996) merely serves to highlight the desperate need for research from a fresh therapeutic approach.

1.3.4 Fixed or Removable Bite Jumping Appliances

Human studies can be difficult to compare as some have involved fixed appliances (no patient cooperation required) or removable appliances such as the Twin-block, in which hours of wear per day may vary with patient compliance (Cozza et al., 2006). Fixed appliances, such as the Herbst appliance, induce twenty-four hour wear and thus should be the 'gold-standard' in terms of best expected outcome (Johnston, 1996). A systematic review by Cozza and co-authors, (2006) found that in terms of appliances, the Herbst appliance showed the highest coefficient of efficiency at 0.28mm of sagittal improvement per month of wear, as opposed to the Twin-block at 0.23mm per month (Cozza et al., 2006). A study by Schaefer *et al.* (2004) compared the results of two-phase therapy in Class II patients using a Herbst appliance and a Twin-block. It was concluded that both produced similar results at the end of the second phase of treatment and normal dentoskeletal parameters were achieved. The Twin-block seemed slightly more efficient in correcting the molar relationship and the sagittal maxillo-mandibular relationship, than the Herbst. Also a greater elongation of the mandibular ramus was noted with the Twin-block appliance. Another interesting feature of this study was that although significant patient compliance was required for Twin-block treatment, it was not a factor in determining treatment success (Schaefer et al., 2004). A randomized controlled clinical trial by O'Brien et al. (2003) studied 215 patients who underwent either Herbst or Twin-block therapy. They found that there was no difference in treatment time between the groups, there was a lower 'failure to complete' the functional therapy with the Herbst (12.9%) compared with the Twin-block (33.6%), and there was no difference between the skeletal and dental changes. However, there was significantly more breakages and repairs needed for the Herbst group (O'Brien et al., 2003b). It is the author's opinion that such a small difference may merely reflect the need for careful case selection when choosing an appliance type.

In an analysis of several Herbst studies, reiterating Johnston's opinion that a fixed functional should be the ruler by which the efficacy of mandibular propulsive therapy should be measured, it was found that there was a difference on average of 0.1 mm of correction or deterioration of the 'apical base change' over 6 month increments between the maxilla and mandible, several years post-treatment (Johnston, 1996). It would seem that *"condylar growth is slightly modifiable in terms of amount and greatly modifiable in terms of direction" (Johnston, 1996).* Whether this growth is equivalent to that which is inherently determined is, at present, impossible to assess in the individual patient.

1.3.5 Human Studies and Differential Sagittal Correction of the Maxilla and Mandible

It has been suggested that bite jumping appliances can redirect condylar growth as well as stimulate length beyond the genetically predetermined limits (McNamara, 1973, Woodside, 1998, Voudouris et al., 2003a). Further, that bite jumping appliance use actually inhibits the natural downward and backward growth of the glenoid fossa and post-glenoid spine, resulting in the fossa and spine being repositioned anteriorly (Voudouris et al., 2003b). It would seem that the literature is divided. Some studies claim that mandibular length can be increased with propulsive therapy (Bishara and Ziaja, 1989, McNamara et al., 1990, Ghafari et al., 1998). Others suggest that it cannot be altered more than is genetically predetermined, and that no increase in length is observed when compared with controls (Robertson, 1983, Nelson et al., 1993, Pancherz, 1997, Rudzki-Janson and Noachtar, 1998, Chen et al., 2002). Studies examining increases of mandibular length in the long-term would support this notion (Cozza et al., 2006).

It is essentially a forward sagittal position of the mandible, and hence the chin, that is ultimately the desired outcome of treatment (Collet, 2000). As previously mentioned, an increase in mandibular length can be negated if a clockwise rotation of the mandible occurs in conjunction (McNamara et al., 1990, Burstone, 1997, Collet, 2000). Correction specific to the lower jaw only, if any, may come from 1) mandibular growth, 2) glenoid fossa remodeling, or 3) a combination of both. A systematic review by Chen (2002) mentioned the need for a greater number of randomized clinical trials (RCTs) in the evaluation of functional appliances (Chen et al., 2002, Cozza et al., 2006). It would seem within the literature that there is significant evidence that bite jumping appliance results may be short lived and minimal a few years post-treatment (Weislander, 1993, Johnston, 1996). A RCT by Tulloch and co-authors (1998) found that for children with moderate to severe Class II problems, early treatment followed by later fixed appliances did not produce significant differences in skeletal or dental relationships compared with one-stage treatment. Additionally the severity of the problem, and the treatment timing are not major influences on the final outcome (Tulloch et al., 1998). This finding has been supported by multiple studies showing that one-stage fixed appliance treatment produces very similar results to two-phase (functional appliance and fixed appliances) treatment for the Class II patient. Although an initial skeletal correction may be evident at the end of functional appliance wear, it has not been shown to be above and beyond that which occurs in the absence of initial therapy (Livieratos and Johnston, 1995, Johnston, 1996, Tulloch et al., 1990, Keeling et al., 1998, Tulloch et al., 1998, Tulloch et al., 2004, Dolce et al., 2007, O'Brien, 2009).

It is commonly thought that bite jumping appliances apply a backwards and/or restraining force upon the maxilla. However, some studies do not demonstrate this to be true to any great degree (Livieratos and Johnston, 1995, Keeling et al., 1998). Additionally, most cephalometric studies use A-point which is subject to considerable dentoalveolar modification via movement of the maxillary incisors, to evaluate sagittal maxillary position. A true answer to the orthopaedic deceleration of maxillary forward growth possibly remains unanswered.

Functional appliances have been shown to result in additional proclination of the lower incisors leading to a greater incidence of extractions in a second phase of fixed brace treatment than controls or those treated with headgear (Tulloch et al., 1998). The results of this RCT indicate that force is directed to the dentition producing part of the correction. Perhaps bite jumping appliances, as they currently stand, are just another means of gaining dentoalveolar correction (Tulloch et al., 1998).

1.3.5.1 A needle in a haystack: a case study of identical twins

It is often said amongst clinicians that if monozygotic twins could be studied, we would ultimately know the answer to the question, can we grow mandibles? In an activator study, Auf der Maur (1980) incorporated two different amounts of mandibular protrusion into his propulsive appliances and inserted the differing appliances into one set of identical twin boys. It was found that the mandibular length increased by 6 mm for the first twin, and by 9 mm for the second twin. This increase in length was found to correlate with the greater propulsion built into the second twin's appliance (Auf der Maur, 1980). This stand-alone case by no means produces any real answers for the enduring question of growth modification, as studies examining the similarities of skeletal discrepancies amongst twins are non-existent. This case-report does however highlight that there is a hole within the literature.

1.3.6 Timing of Treatment

Growth modification with functional appliances aims to provide a new muscular and functional environment for the facial bones and it encourages growth changes of either the maxilla or mandible. They will offer the greatest benefit to a patient who is actively growing and have a limited role in the treatment of adults who have completed their facial growth (Barton and Cook, 1997). Regardless of whether the appliance is repositioning the mandible or manipulating eruption of the teeth, active growth is most desirable. Ideally this should be during the pubertal growth spurt or just before. The work of Bjork has shown that as patients increased in age, the efficacy of functional appliances reduced (Bjork, 1951). Assessing when the pubertal growth spurt is likely to occur is an essential part of the treatment planning process. Biological indicators which can be used include increase in body height, skeletal maturation of hand and wrist, dental development and eruption, menarche, breast and voice changes and cervical vertebrae maturation (Baccetti et al., 2000) . In patients with Class II malocclusions related to mandibular retrognathia in part, it has been recommended to commence functional appliance therapy in the late mixed dentition stage. This is supported by studies which show a greater mandibular growth response when treatment is commenced in the circumpubertal growth period (McNamara et al., 1985, Hägg and Taranger, 1982).

The timing of functional appliance treatment attracts controversy. Tulloch et al. raised the question of whether there is a benefit for adolescent patients from two-stage treatment; that is skeletal growth modification followed by fixed appliance therapy in comparison to patients who only have Phase II fixed appliance therapy only. They found that those patients who had a single phase of fixed appliance had shorter treatment times compared to those who had undergone early treatment (Tulloch et al., 1998). Their study also supported the idea that any skeletal changes in early treatment, particularly the increase in mandibular growth, may simply be attributable to an acceleration in growth rather than a net gain (Livieratos and Johnston, 1995). Tulloch et al. concluded that early treatment followed by later comprehensive treatment does not produce any major differences in jaw relationship or dental occlusion compared with later one-stage treatment (Tulloch et al., 2004).

However, Pancherz and Hägg (1985) found the ideal time for the Herbst appliance treatment was in the permanent dentition at or just after the peak of the pubertal growth spurt (Pancherz and Hägg, 1985). This study also found that at this time, there was less effect on proclination of the mandibular incisors (Pancherz and Hägg, 1985). They found that mandibular growth stimulation was possible in post-adolescent young adults and proposed a new concept in the treatment of Class II therapy where they have suggested an alternative to orthognathic surgery in older Class II subjects (Pancherz and Hägg, 1985). Pancherz has also suggested that patients treated later with Herbst appliance therapy may be more stable because with the eruption of the permanent dentition the promotion of good interdigitation of the cusps of the teeth occurs after therapy (Pancherz and Fischer, 2003). However, ultimately in older patients the treatment effects are limited to the dentoalveolar region (Pancherz, 1997).

Another indicator for early treatment includes prevention or reduction of risk of dental trauma in adolescents with large overjets and prominent incisors and it has been suggested that early functional appliance therapy may decrease the risk of trauma (Fricker 1998). Finally, an important point of note is the potential psychological and social benefits of early orthodontic treatment (DiBiase, 2002, O'Brien et al., 2003a). In a RCT randomized controlled study by O'Brien et al. (2003), it was found that children who received early orthodontic treatment with a Twin-block appliance reported higher self-concepts and more positive childhood experiences than controls who received no intervention (O'Brien et al., 2003a).

1.3.7 Animal Studies

In histomorphometric primate and rodent experiments, results have been shown which include: new bone formation at the posterior border of the ramus of the mandible, and new bone deposition on the anterior and inferior surface of the post-glenoid spine in response to bite jumping appliance wear (McNamara and Carlson, 1979, Hinton and McNamara, 1984, Woodside et al., 1987, Voudouris et al., 2003b, Chayanupatkul et al., 2003). Further, new bone has been shown to form in the posterior region of the condyle of rats undergoing propulsive appliance treatment (Charlier et al., 1969, Petrovic et al., 1981, Chayanupatkul et al., 2003). However, there is some inconsistency in the histological results; a study by Ghafari and Degroote (1986) showed thinning of the posterior condylar cartilage in rats (Ghafari and Degroote, 1986). Skeletal assessments in rodents have indicated that increased mandibular length is achieved with bite jumping appliances. In a study by Xiong and co-workers (2004) in adult rats, continuous bite-jumping resulted in a lengthening of the condylar process (Xiong et al., 2004). Petrovic also reported greater mandibular length achieved with bite jumping appliances (Petrovic et al., 1981). Radiographic assessments of growing primates indicate accelerated condylar growth during the experimental period as well as a redirection of condylar growth in the posterior direction. However, additional growth was not observed at the end of the experiment (Woodside et al., 1987). It would appear that there are some discrepancies within the literature as to whether additional mandibular growth and/or glenoid fossa remodeling does produce increased mandibular sagittal projection. Few studies support both histological data with skeletal findings, as a finding in one medium may not be reflected in the other. As Meikle aptly said over 45 years ago, *"The addition of several layers of cells to the condylar head described by some investigators, although impressive under the microscope, would appear unlikely to alter the length of the mandible significantly as claimed, reminding one that all that glitters is not gold"* (Meikle, 1970, Whetten and Johnston, 1985).

1.4 Biomechanical Theory of Bite Jumping Appliances

For many years it was believed that bite jumping appliances induced strengthening or 'hyperactivity' of the lateral pterygoid muscle, which in turn led to growth modification of the condyle (Charlier et al., 1969, McNamara, 1973, Voudouris et al., 2003a). Petrovic remained devoted to his idea that lateral pterygoid was the *"final common link"* (Petrovic et al., 1976) governing mandibular condylar growth. The role of the lateral pterygoid in condylar growth is controversial and has been questioned (Goret-Nicaise et al., 1983). Hinton's findings were in agreement with Petrovic's, showing a significant decrease in condylar mitotic activity post-myotomy (Hinton, 1990, Hinton, 1991). However, Whetten and Johnston, showed that the presence or absence of the lateral pterygoid muscle had little effect on condylar sagittal position during growth (Whetten and Johnston, 1985). Petrovic also believed that mandibular advancement induced by his 'hyperpropulsive appliance' led to hyperactivity of the lateral pterygoid muscle and consequently, the retrodiscal pad, leading to an increased rate and amount of condylar growth (detectable in the posterior region) with a measurable increase in mandibular length in rodents (Charlier et al., 1969, Petrovic et al., 1976, Petrovic et al., 1981). McNamara found that an increase in postural activity measured via electromyography (EMG) of the lateral pterygoid muscles correlated with increased proliferation of the mandibular condyle in monkeys (McNamara, 1973). In contrast, Sessle et al. (1990) found that the EMG activity of the lateral pterygoid (superior and inferior head) in monkeys was significantly depressed during continuous mandibular advancement and only began to recover after 12 weeks of wear (Sessle et al., 1990). In 2003, Voudouris showed that Herbst placement in monkeys (*Macaca fascicularis*) induced significant bone formation in the glenoid fossa however, perceived increases in mandibular length were not attributable to lateral pterygoid hyperactivity (Voudouris et al., 2003a). Although it is likely anatomically that the retrodiscal pad is stretched when a bite-jumping appliance is placed, the theory that hyperactivity and/or that a causal role of the lateral pterygoid in mandibular condylar growth during bite-jumping therapy exists is not correct (Johnston, 1996, Voudouris et al., 2003b).

Auf der Maur (1980) suggested that a bite jumping appliance influences the balance at rest of the protrusive (lateral pterygoid and to some degree the medial pterygoid) and retracting (temporalis and masseter) muscles of the mandible. With an activator in place, the protrusive muscles are slackened, and the retracting muscles are under strain, as their insertion points are now further from their origin then they would be in normal resting position. The muscle spindle reflex increases their tone and there is tension in the elastic fibres (Auf der Maur, 1980). These muscles attempt to restore the mandible to its' habitual rest position and this is inhibited by the appliance. This retraction force is transmitted to the appliance which pushes the mandibular teeth in the alveolar process forwards, and the maxillary teeth backwards (Auf der Maur, 1980) (Figure 1). As mentioned previously, some remodeling of the temporomandibular joint also occurs (Voudouris et al., 2003b).

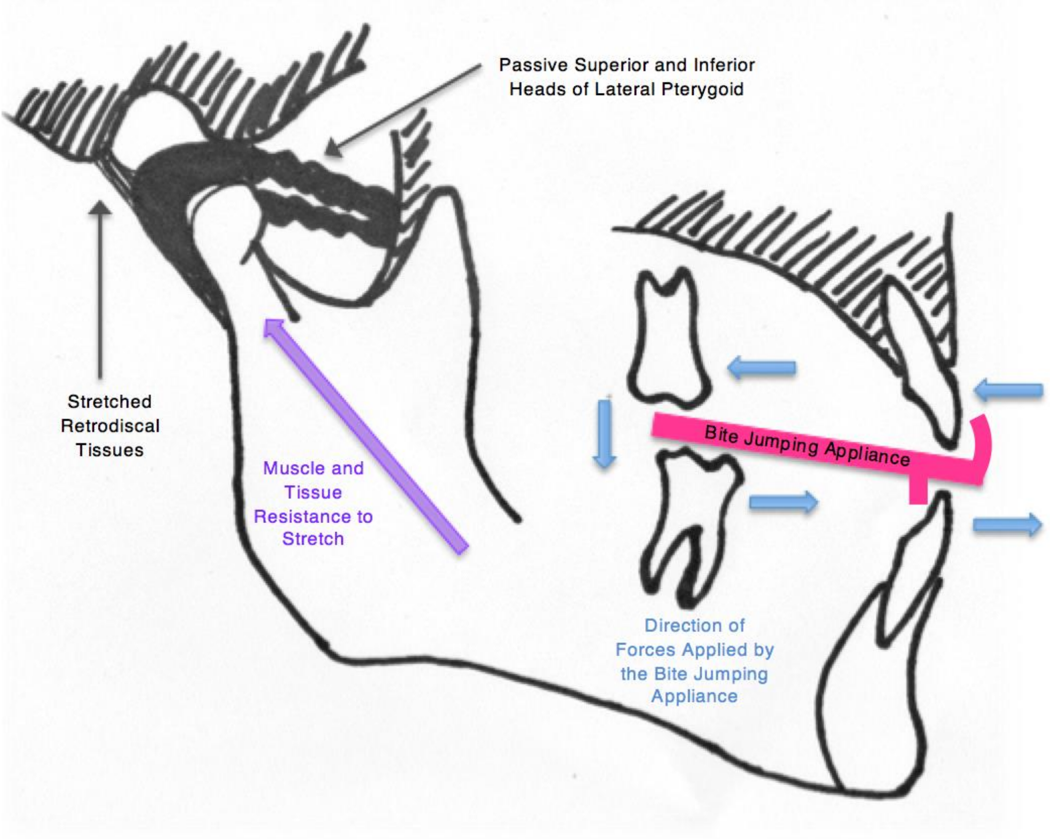


Figure 1: Direction of forces induced by the insertion of a Bite Jumping Appliance: a distal force to the maxilla and upper dentition, a protrusive force to the lower jaw and dentition, and the stretch resistance induced in the muscles and soft tissues associated with the mandible and temporomandibular joint.

In 2000, Voudouris published a theory: *"the theory of growth relativity essentially states that bone growth modification occurs relative to two elements: the retrodiscal tissues are stretched reciprocally, similar to a large elastic band, between the fossa and the displaced condyle during the expansion of the growing facial complex* (Voudouris and Kuftinec, 2000, Voudouris et al., 2003a)." Further, "*the displaced condyle modifies in a radiating manner relative to the fossa, and the fossa grows in a radiating fashion relative to the condyle* (Voudouris and Kuftinec, 2000, Voudouris et al., 2003a)." The 'large elastic band' being the elastic forces conducted by the posterior attachment of the articular disc to the condylar head and glenoid fossa during protrusion (Voudouris et al., 2003b) (Figure 2). Anatomically this is supported as the superior head of the lateral pterygoid muscle attaches directly into the anterior disc to oppose the retractive forces of the elastic fibres in the upper lamella of the connection between the posterior disc and the joint capsule inserting into the squamotympanic fissure (Nanci, 2003). The direction of tension exerted by the posterior fibrous attachment of the disc and capsule correlates with the remodeling of the posterior portion of the glenoid fossa. These findings were in agreement with other studies in humans and primates (Hinton and McNamara, 1984, Woodside et al., 1987).

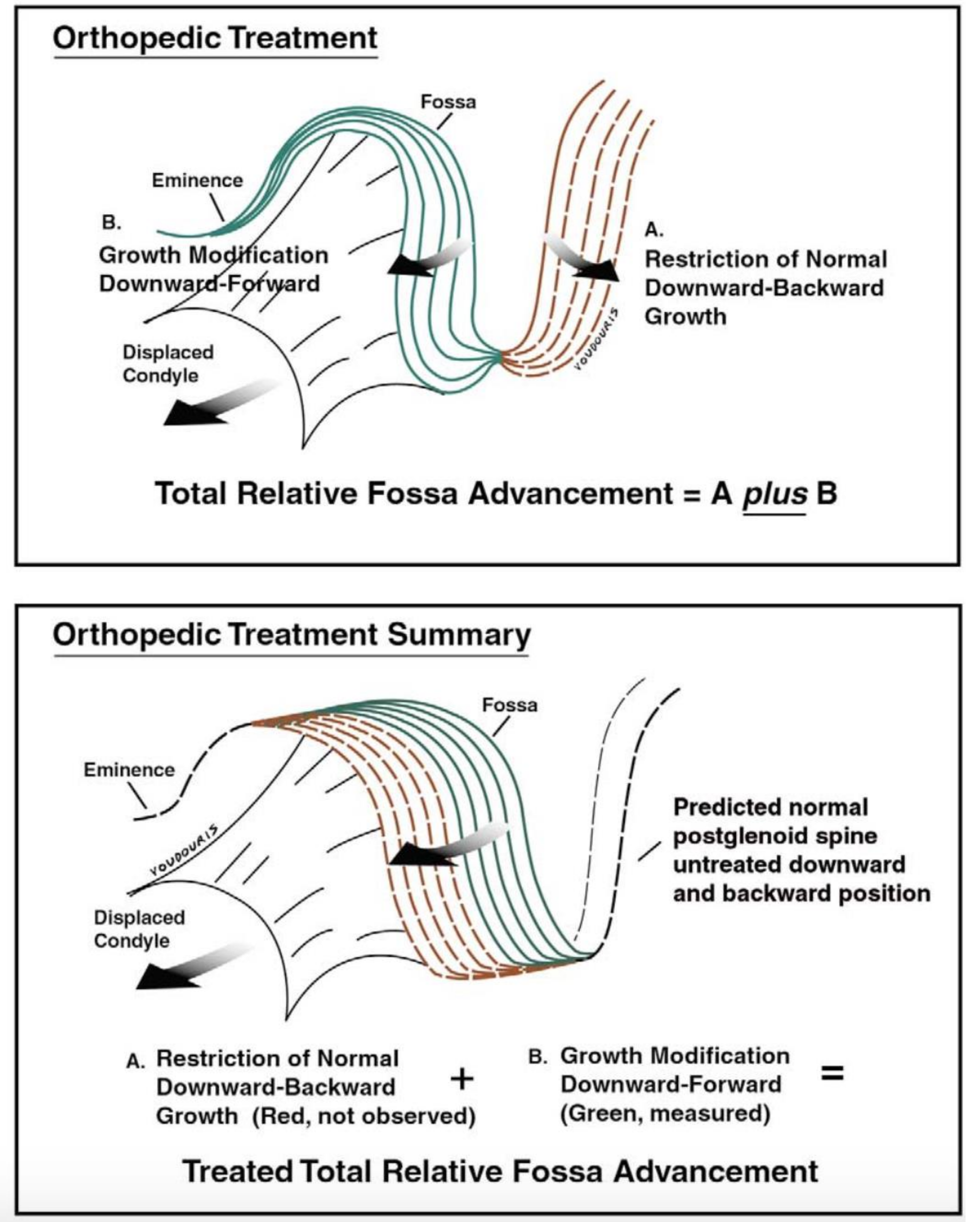


Figure 2: Voudouris's Theory of 'Growth Relativity':
Remodelling/redirection at the glenoid fossa during growth and orthopaedic treatment. Normal growth in red (A) is shown; this is restricted during appliance therapy. The green lines show forward and downward growth in experimental animals treated with bite jumping appliances (B). It is suggested that total glenoid fossa advancement is the sum of A and B. Reproduced with permission (Voudouris and Kuftinec, 2000).

1.5 A New Biomechanical Theory for Bite Jumping Appliances

The findings of numerous animal studies would seem to support the theory of growth relativity (Meikle, 1970, McNamara, 1973, Woodside et al., 1987, Voudouris et al., 2003a). However, there are other factors to consider. The resting position of the mandible is achieved because the elevator muscles contract in response to gravity to reach a point of equilibrium. The trigeminal myotatic (stretch) reflex is activated and under the influence of higher brain centres through trigeminal gamma motor neurons; there is resting muscle tone in the elevator muscles (Woda et al., 2001). The jaw-closing muscles in humans are richly endowed with muscle spindles, however the jaw-opening muscles are not (Miles et al., 2004). It would appear that the stretch reflex induced by the action of the muscle spindles within the intrafusal fibres of muscle, play an important role in habitual mandibular position, and upon stretching of the mandibular muscular envelope, the myotatic reflex is increased (Woda et al., 2001). It is apparent that in forced passive protrusion, as is the case with bite jumping appliances, there is a stretching of the neuromuscular complex, in particular the masseter and the temporalis muscles show an increase in postural EMG activity (McNamara, 1973, Miralles et al., 1988, Aagarwal et al., 1999, Song et al., 2001, Voudouris et al., 2003b). Although there is evidence to suggest that remodelling and adaptation of the muscles to this increased bite-opening and forward positioning may occur with time, (McNamara, 1973) muscle activity has also been implicated in relapse post-treatment (Voudouris and Kuftinec, 2000, Voudouris et al., 2003b). This knowledge leads to a number of very complex questions:

1. If the muscles are attempting to return to their rest position via the myotatic reflex, is this 'pull-back' force reducing the potential elastic 'retractive force' of the retrodiscal and capsular attachment, therefore reducing the efficacy of temporomandibular remodeling and/or growth that may occur in response to the bite jumping appliance?

2. Is the biomechanical force generated by these appliances being 'wasted' by being directed mainly to the dentition resulting in the dentoalveolar compensations (Bishara and Ziaja, 1989, Macey-Dare and Nixon, 1999, Collet, 2000) commonly induced by bite jumping appliances?

3. If the spindle reflex 'pull-back' were to be reduced, is it possible that a greater force would be transmitted directly to the temporomandibular joint and less force would be transmitted to the dentoalveolus? Could it be that the current action of the bite jumping appliance is a frustrated scenario, rather like the strapper* attempting to pull the horse forward by his lower front teeth, while the jockey pulls back on the reigns?

4. Further, does muscular pull-back contribute to relapse of the Class II correction?

**strapper: definition – a person who grooms racehorses (Australian noun)*

1.5.1 The Myotatic Biomechanical Theory of Bite Jumping Appliances

The above questions lead to the development of a new theory for bite jumping appliances by the author that this work aims to investigate.

Simply drafted, the '**Myotatic Biomechanical Theory'** states:

"the myotatic reflex of the temporalis and masseter muscles induced by the insertion of a bite jumping appliance, results in the transmission of this muscular 'pull-back' force to the dentoalveolus, thereby reducing the efficacy of the elastic 'retractive force' of the retrodiscal lamellae, leading to greater dentoalveolar changes and reducing temporomandibular skeletal modification."

1.6 Botulinum Neurotoxin Type A (BoNT/A)

1.6.1 Introduction

Clostridium botulinum and consequently the disease it causes, botulism, have been studied since the 19th century (Dickerson and Janda, 2006). Botulism is a disease caused by the Botulinum neurotoxins (BoNTs) and results in peripheral neuromuscular blockade and paralysis. *Clostridium botulinum* is a widespread spore-forming, rod-shaped, Gram-positive, anaerobic bacillus. The spores are distributed in soil and may contaminate food sources such as vegetables and meat (Samaranayake, 1996). The lethal dose for humans is approximately 0.001 micrograms per kilogram of body weight although this may vary with the route of administration of the toxin (Franz et al., 1997). Although BoNTs are associated with contaminated foods causing illness, other means of infection include inhalation, wounds, or colonisation of the intestine of infants (Samaranayake, 1996). Generalised muscle weakness ensues, and in severe infections respiration and autonomic function are affected; which may lead to asphyxiation and death (Dickerson and Janda, 2006). It is important to note that the insult to the host is not one of initial cell-death, but rather an inhibition of the release of acetylcholine (ACh) from healthy cells (Dickerson and Janda, 2006). The release of ACh is inhibited for months leaving the muscle or gland paralysed. In the United States, the Centers for Disease Control and Prevention classify BoNT/A among the *"six highest-risk threat agents of bioterrorism"* (Dickerson and Janda, 2006).

Several different clostridial bacterial species produce botulinum neurotoxins (Aoki, 2005). Different neurotoxin serotypes, known as A, B, C_1, D, E, F, G and the recently discovered H are produced by specific strains of bacterium with Type A being the most potent and longest lasting (Aoki, 2005, Dickerson and Janda, 2006, Clark et al., 2007, Barash and Arnon, 2014). The serotypes differ in toxicity and molecular site of action (Dickerson and Janda, 2006).

1.6.2 BoNT/A Mode of Action

The BoNT/A molecule is a single-polypeptide chain that must be cleaved for activation by intra or extracellular proteases into an active dimer. The dimer consists of Heavy Chain (HC) 100-kDa and Light Chain (LC) 50kDa portions bound by disulfide bonds (Dickerson and Janda, 2006, Aoki, 2005, Ramachandran and Eastwood, 2006). Trypsin acts as a protease for commercially manufactured preparations, however some clostridial strains contain endogenous proteases (Ramachandran and Eastwood, 2006).

A widely accepted model for the action of BoNT/A includes the following initial steps: binding to the neuronal membrane, followed by receptor-mediated endocytosis. In the more alkaline cytosol the LC dissociates from the HC and then escapes from the endosome. The LC then cleaves SNAP-25 via endoprotease action. SNAP-25 is a component of the SNARE complex on the neuronal membrane, a protein receptor that mediates the fusion of vesicles to the synaptic membrane where the neurotransmitter acetylcholine (ACh) is released at the neuromuscular junction allowing muscle contraction to occur. Cleaving this complex prevents muscle contraction from occurring (Koriazova and Montal, 2003, Simpson, 2004, Ramachandran and Eastwood, 2006)(Figures 3 and 4). The SNARE complex is formed by several proteins: synaptobrevin, syntaxin, and SNAP-25 (molecular weight 25kDa) (Blasi et al., 1993). The different serotypes target varying portions of the SNARE complex via specific binding and protease activity (Borodic, 2007).

The cleavage of the SNARE complex occurs in a dose-dependent manner (Blasi et al., 1993). The multi-step process behind neurotoxin action explains the delayed onset of muscle paralysis (Aoki, 2005). Normal exocytosis begins to resume after turnover of the SNARE protein complex (Foran et al., 2003). Initially new accessory nerve sprouts re-establish conduction until the parent terminal becomes functional again and these sprouts retract (de Paiva et al., 1990, Foran et al., 2003). Clinically in humans, muscle weakness is observed 1 to 2 days post-injection and is maintained for 12 to 16 weeks (Foran et al., 2003, Meunier, 2003, Carruthers and Carruthers, 2004). Larger unit doses are required for larger muscles. The concentration of the toxin is important also as more concentrated doses diffuse less and are used to target smaller muscles (Carruthers and Carruthers, 2004). A small volume of a concentrated dose typically allows for precision placement and keeps the effects more localized (Carruthers and Carruthers, 2004). Although an exact dose to achieve the desired muscle response per muscle has not been elucidated, it is likely that it varies with the density of neuromuscular junctions, and any pre-existing pathology of the muscle (Francisco, 2004, Ramachandran and Eastwood, 2006).

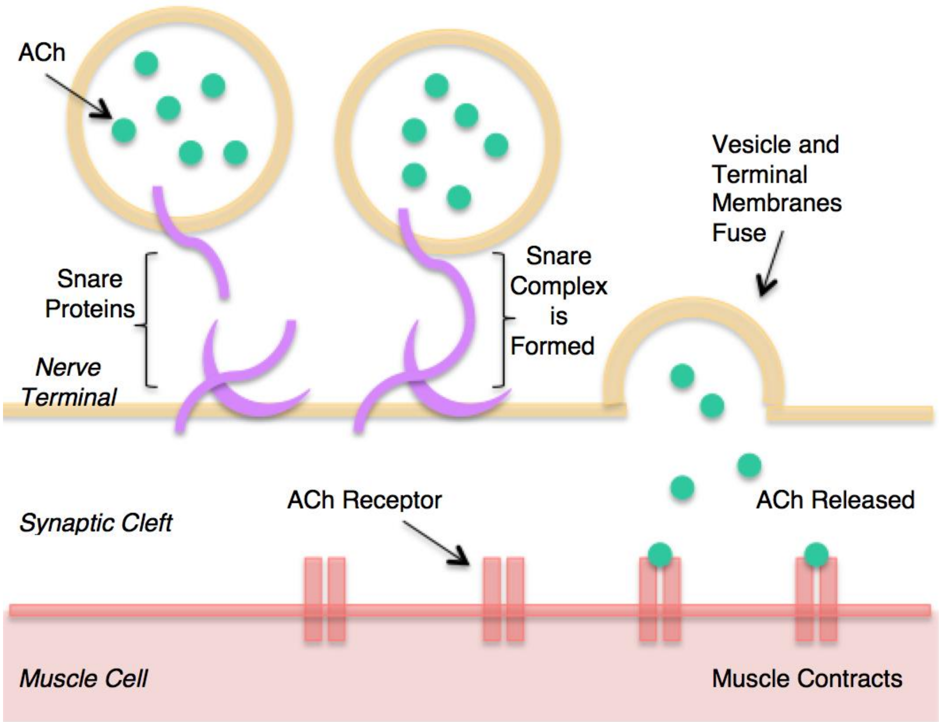


Figure 3: Normal Neurotransmitter Release:
The SNARE complex facilitates the fusion of vesicles to the synaptic membrane where the neurotransmitter acetylcholine (ACh) is released into the synaptic cleft allowing muscle contraction to occur.

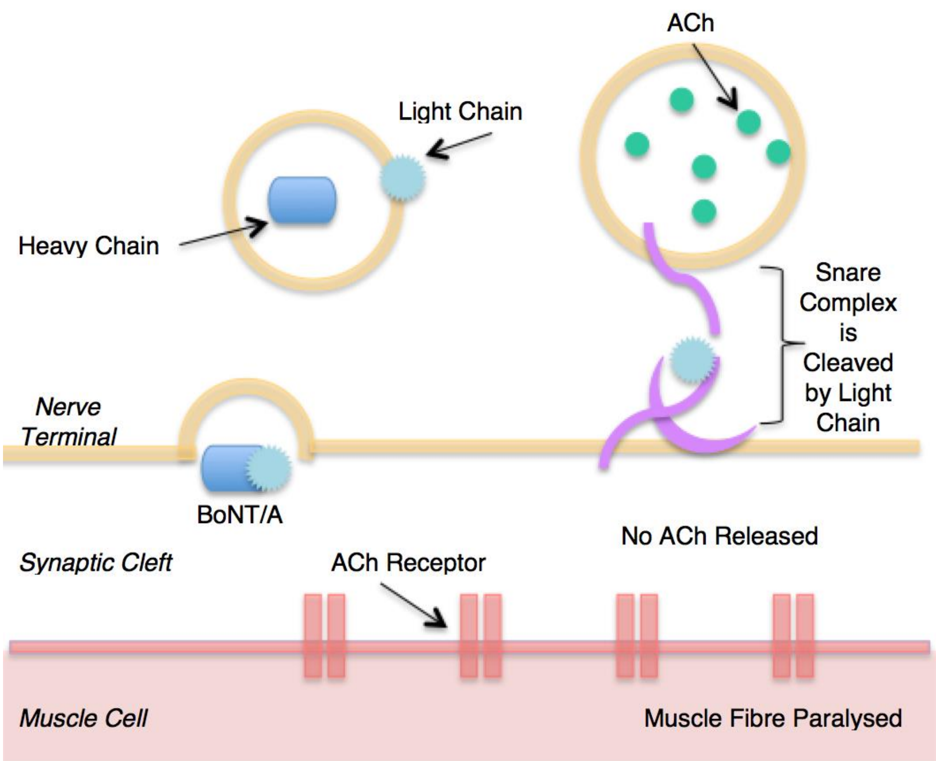


Figure 4: Snare Complex is Cleaved by BoNT/A:
BoNT/A binds to the neuronal membrane and is endocytosed, the light chain (LC) escapes from the endosome, and cleaves the SNARE complex on the neuronal membrane which is responsible for acetylcholine (ACh) release from the neuromuscular junction; hence preventing contraction from proceeding.

Botulinum toxin primarily targets all cholinergic sites including: neuromuscular junctions, sympathetic and parasympathetic ganglia, and postganglionic parasympathetic and sympathetic sites that release acetylcholine, although the latter are rare (Simpson, 2004). It has been demonstrated that extrafusal muscle fibres are innervated via neuromuscular junctions at a defined end-plate zone along the muscle. This end point is at the midpoint of the fibre length (Coers, 1958). Limb muscles display a single innervated band, however a more complex arrangement exists in multi-pennate muscles (Ramachandran and Eastwood, 2006). This complex arrangement may be particularly relevant to the muscles of mastication and facial expression as these muscles display differing compositions and fibre orientations related to function (Miles et al., 2004). For maximum clinical effects of BoNT/A injections, the toxin must be injected inside the fascial compartment of the muscle. The correct dose is important to neutralize neuromuscular activity. Volume is important to prevent unwanted diffusion (Ramachandran and Eastwood, 2006).

1.6.3 Botulinum Neurotoxin Use

Botulinum toxin A, was originally used in the field of ophthalmology in the 1970s (Kane, 2002). Today, BoNT/A is an increasingly invaluable therapeutic agent in conditions targeting neuromuscular action, autonomic action, and in some instances pain (Dickerson and Janda, 2006). BoNT/A is the serotype that has been used most as a therapeutic agent, although types B and F have also been used as they have a shorter duration of action (Ramachandran and Eastwood, 2006).

It is well known and accepted that BoNT/A has particularly high use in cosmetic procedures to reduce facial wrinkles resulting from muscle hyperactivity. BoNT/A is used to treat such conditions as hyperhidrosis, blepharospasm, strabismus, hemifacial spasm, genitourinary disorders, sialorrhea, axillary hyperhidrosis, gastrointestinal disorders, cervical dystonia, tension headaches, migraine, back pain, dysphagia, dysphonia, bruxism, TMD, masseteric hypertrophy, the gummy smile, and spasticity (such as in stroke patients or those with cerebral palsy) (Zalvan et al., 2004, Polo, 2005, Banerjee et al., 2006, Clark et al., 2007, Petrus et al., 2007).

1.6.4 Commercially Available Products

Today there are a number of commercially available toxins of the Type A serotype. Two of the most common preparations are Botox® (made by Allergan, United States of America) and Dysport® (produced by Ipsen, United Kingdom). Botox® and Dysport® are packaged as purified botulinum toxin A (BoNT/A) which is a stable, sterile, vacuum-dried powder that is diluted with saline. Care must be taken when comparing previous studies using BoNT/A. Varying serotypes and subsequent commercial preparations differ in their cellular modes of action, bacterial strain, and manufacturing, and thus are not interchangeable (Carruthers and Carruthers, 2004). Different brands of the toxin are not necessarily comparable in terms of dose. Botox® is not clinically equivalent to Dysport® used in this study. Botox® reports 100

U (5 ng of protein toxin) per vial; Dysport® 500U (12.5 ng of protein toxin) per vial. One U represents the amount of toxin lethal to 50 per cent of Swiss-Webster mice (LD_{50}) after intraperitoneal injection. However, different companies use different biological mouse assays which leads to difficulty in comparing dose-ratios in the published literature (Ramachandran and Eastwood, 2006, Tan and Jankovic, 2000). Randomized controlled trials have reported that clinically, 3 U of Dysport® is equivalent to 1 U of Botox in humans (Wohlfarth et al., 2009).

1.7 Releasing the Mandibular Neuromuscular Envelope with BoNT/A

BoNT/A injections inhibit acetylcholine exocytosis at the neuromuscular junction preventing muscle contraction and leading to localized paralysis (Aoki, 2005). In an attempt to eliminate the issues of scarring from surgical procedures, studies using New Zealand white rabbits and rodents employed BoNT/A as an experimental tool (Kwon et al., 2007, Matic et al., 2007, Tsai et al., 2009). Scarring from surgical procedures often further alters the biomechanical environment and normal dietary function of experimental animals (Matic et al., 2007). It has been shown in the jaw muscles of rats that BoNT/A is capable of blocking the gamma motor neurons of the myotatic reflex, along with alpha motor neurons (Filippi et al., 1993). It would seem that local injection BoNT/A may reduce the stretch reflex of specific masticatory muscles, which may impact upon the skeletal and dental outcomes of normal growth and/or bite-jumping therapy, hence providing insight into the role in therapy that these muscles play.

1.8 Summary of Literature Review

A Class II malocclusion is present in 20% of the entire population; many of these patients possess an underlying skeletal discrepancy (Bishara, 2001). The question, ‘can we grow mandibles beyond that which is genetically predetermined?’ cannot truly be answered until all components affecting growth and therapy, including the effect of altering the function of the mandibular musculature, are understood.

2 DEVELOPING THE RESEARCH PROJECT

2.1 Objective

The primary objective of this body of work is to examine the ‘Myotatic Biomechanical Theory of Bite Jumping Appliances’ using a refined animal model and BoNT/A as a research tool to inhibit the stretch reflex of the superficial jaw closing muscles (masseter and temporalis).

2.2 Aims

The aim of this research is to cephalometrically examine the short-term and long-term craniofacial skeletal effects of bite-jumping appliance therapy and/or BoNT/A injections to the temporalis and deep masseter muscles in the rodent model. A second aim was to study the effects of BoNT/A as part of a long-term retention regime on skeletal growth.

2.3 Null Hypothesis

BoNT/A induced partial paralysis of the temporalis and deep masseter muscles of the juvenile rat during bite-jumping appliance wear will have no influence on craniofacial skeletal growth, over the short-term or long-term, with or without a retention regime involving continued BoNT/A application.

2.4 The Experimental Design

2.4.1 Rodent In Vivo Experiments

Bite-jumping appliances have previously been trialed in animal models, including rodents; additionally cephalometric radiographs have been used to evaluate effects of these appliances and also craniofacial growth in general (Hughes and Tanner, 1970, Petrovic et al., 1981, Tonge et al., 1982, Ghafari and Degroote, 1986, Petrovic et al., 1991, Tsolakis and Spyropoulos, 1997, Woodside, 1998, Voudouris et al., 2003b, VandeBerg et al., 2004, Xiong et al., 2004, Rabie and Al-Kalaly, 2008).

2.4.2 Pilot Work

Pilot work was undertaken by the author at the University of Queensland between 2007 and 2009 (Appendix 1). This work established the feasibility of using BoNT/A in a rodent model to study growth as well as establishing the most appropriate dosage to be used.

2.4.3 Sample Selection

Due to their rapid growth rate compared to humans, rodents have frequently been used as a low-cost experimental model for studies of growth and orthodontic treatment. Many studies examining bite-jumping appliances have commonly used outbred Sprague-Dawley or Wistar rats (Tonge et al., 1982, Ghafari and Degroote, 1986, Easton and Carlson, 1990, Nicolay et al., 1991, Takahashi et al., 1995, Tsolakis and Spyropoulos, 1997, VandeBerg et al., 2004). Outbred animals are not an ideal experimental model for several reasons: two outbred animals can vary significantly with regard to genotype, and without specific genetic testing, little is known about the genotype of an individual animal. Consequently, a much larger sample size is required to overcome the fact that a control and experimental animal will be different genetically. Thus, identification of a true experimental effect is much more difficult within an outbred sample. Long-standing inbred strains are essentially identical genetically, although mutations can cause some variation, the differences are much lower than in outbred lines. Utilising a homogenous inbred strain can significantly increase sample power, as much lower numbers of animals are required to observe true experimental effects (Festing, 2002, Festing and Altman, 2002, Johnson, 2002, Festing, 2009). The Wistar Kyoto (WKY) inbred strain was selected as part of the aim to achieve a more homogenous population than previous studies using outbred species and to avoid the added time and experimental costs of using only litter-mates from an outbred line. Male animals were chosen due to their larger somatic size. Juvenile rats were chosen to obtain a circum-pubertal sample (Hughes and Tanner, 1970, Petrovic et al., 1981, Kiliaridis et al., 1985). A three week experimental period in juvenile rats can be approximated to about 18 to 24 months of growth in humans (Quinn, 2005a). The maturity gradient of craniofacial growth in rats has been demonstrated to be similar to that of humans making the rat model useful for experimental interventions (VandeBerg et al., 2004). Relative growth in mandibular components from pre-pubertal to adulthood, has also been shown to be similar to humans (Losken et al., 1992). Adult or mature morphological characteristics of the rat begin between 76 to 180 days of age, and are complete by about 120 to 180 days of age (Hughes and Tanner, 1970, Petrovic et al., 1981).

The alveolus anteriorly, and the mandibular ramus posteriorly, make up two functioning units of the rodent mandible (Klingenberg et al., 2003). Previous studies in rats have equated the sagittal relationship of the posterior, middle and anterior articular fossa and condylar head to be comparable to the temporomandibular joint in humans (Rabie et al., 2001). The articular fossa is virtually non-existent but an articular eminence is present (Luder, 1996). The configuration of the squamomandibular joint and the ligaments holding the joint capsule and posterior disc attachments allow for extensive excursive and incisive mandibular movements (Luder, 1996). Incisor eruption is continuous throughout life in the rodent (Sturman, 1957b). The comparative growth stage of the temporomandibular, and squamomandibular joints, in humans and primates, and rats respectively are similar (Luder, 1996).

2.4.4 Muscles Targeted

This study aims to target those muscles of the rodent which are more consistent with respect to function and anatomical alignment to those in humans, and which are relevant to the hypothesis of this study. Essentially, the naming of the muscles is consistent amongst all mammals. However, muscles are named relative to their attachment to the skull, not necessarily implying similarity of function between species (Herring, 2007). Herring (2007) highlighted this importance, *"the anteriorly directed, fascially subdivided superficial masseter muscle of rodents has little functional resemblance to its relatively vertical and unitary human* *counterpart"* (Herring, 2007). The superficial masseter of rodents is anteriorly directed, the anterior attachment is via a small flattened tendon on the maxilla and the insertion is musculous posteriorly, and is considered a 'jaw protruder' muscle (Weijs, 1973, Weijs and Dantuma, 1975, Hinton, 1991). However, the deep masseter (anterior and posterior parts) originates from the root of the zygomatic process and the zygomatic arch and inserts on the internal aponeurosis of the masseteric ridge which attaches to the lateral body of the mandible (Weijs, 1973). This deep portion of the masseter is anatomically more similar to the human masseter and functions in jaw elevation (Weijs, 1973, Weijs and Dantuma, 1975). The anterior lateral temporal muscle and posterior temporal muscles originate on the lateral portion of the skull along the temporal ridge and insert onto the coronoid process and the aponeouroses of the retromolar fossa and coronoid process respectively (Weijs, 1973). Similar to humans, the temporalis muscles of the rat act to close and retract the mandible (Weijs and Dantuma, 1975) (Figure 5). The lateral pterygoid has a superior part which originates from the rostral border of the orbital surface of the basisphenoid and inserts on the medial side of the articular disc, and an inferior portion which originates from the lateral aspect of the external pterygoid lamina and inserts on the medial condylar process (Weijs, 1973, Byrd and Chai, 1988). The medial pterygoid muscle in the rat originates between the inner and outer pterygoid lamina, has fibres orientated laterally, ventrally, and caudally, and inserts on the medial side of the mandible and may contribute to closing as well as opening and protrusion (Weijs, 1973). Both pterygoid muscles function in mandibular opening and protrusion along with the suprahyoid muscles within the rodent species (Weijs and Dantuma, 1975). The lateral pterygoid in rodents also undergoes controlled lengthening during retrusion, as in humans (Byrd and Chai, 1988).

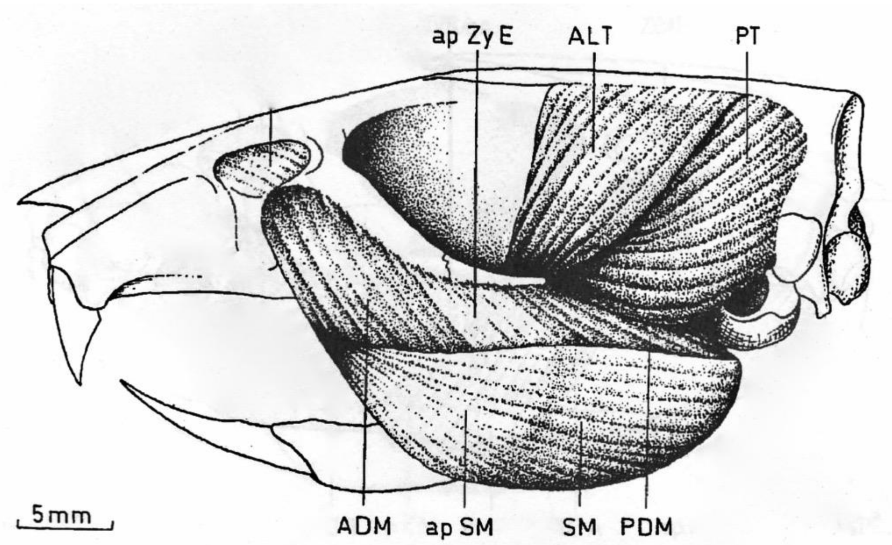


Figure 5: Rodent Muscles of Mastication
ADM = Anterior Deep Masseter; PDM = Posterior Deep Masseter; Ap SM = aponeurosis of Superficial Masseter; SM = Superficial Masseter; Ap ZyE = external aponeurosis of the zygomatic arch; ALT = anterior L Temporalis; PT = Posterior Temporalis (Weijs, 1973).

The hypothesis for this work centres on BoNT/A manipulation of the potential stretch-reflex induced by the placement of a bite-jumping appliance; the insertions of the temporalis and deep masseter muscles are further from their origins at rest with an appliance in place. The medial pterygoid may undergo some vertical stretch with appliance placement; however the need for the animal to maintain some masticatory ability and the difficulty in accessing this muscle for accurate injection experimentally has led to its exclusion from this particular study. The lateral pterygoid in the rodent is not stretched during bite-jumping placement.

Previous studies paralysing only the masseter muscle with BoNT/A, have failed to mention the possibility of compensatory increase in temporalis or other masticatory muscle activity (Kwon et al., 2007, Matic et al., 2007, Tsai et al., 2009). Compensatory activity has been noted to occur in the ipsilateral temporalis muscle if only masseter function is impeded (Carter and Harkness, 1995). Redistributions of the motor cortex resulting in compensatory muscle activity have been noted in the orofacial region and other regions of the body (Franchi, 2002, McCully et al., 2007). To avoid muscle compensations from confounding the results, both the temporalis and masseter muscles were paralysed in unison in this model. Access to the medial and lateral pterygoid muscle is difficult experimentally, and compensatory activity by these muscles cannot be ruled out.

2.4.5 BoNT/A Doses, Onset, and Duration

BoNT/A duration in rodents is dose dependent. This is illustrated in earlier studies in which the onset of partial, and full resolution of paralysis in the juvenile mouse gastrocnemius (calf) muscle was reported to vary from 1-9 days and 15-28 days respectively using doses of 0.4 U to 0.8 U (Keller, 139). A recovery period of 10 days has been reported in adult male rats injected with 5 U into the tibialis anterior muscle (Sellin et al., 1983). Once again, care must be taken when interpreting the results from different laboratories utilising different brands of toxin. The partial and complete recovery from paralysis found in this work was within the scope of the previously reported literature.

Previous pilot work undertaken by the author revealed that for a 2U BoNT/A dose, onset of paralysis was evident within the vibrissae (small muscles on the snout that control whisker movement) at 13.31 ± 0.042 hours. Total paralysis lasted until 7.50 ± 0.83 days (time of first movement) with complete recovery observed at 13.92 ± 2.15 days (Daniels et al., 2009). The onset of paralysis in this work was slightly faster but within the 24 to 48 hour period anticipated for rodents (Meunier, 2003). One reason for this may be the age of the animals. Juvenile rats have a greater neuromuscular junction density in skeletal muscle compared to adult rats; in humans this difference has been linked to faster repair in children than adults and may suggest a need for an increased dosage of toxin for chemodenervation (Ma et al., 2002). Additionally it has been suggested that the nerve terminals in younger animals have a more rapid regenerating capacity, thus perhaps duration is shorter in younger animals (Bambrick and Gordon, 1989).

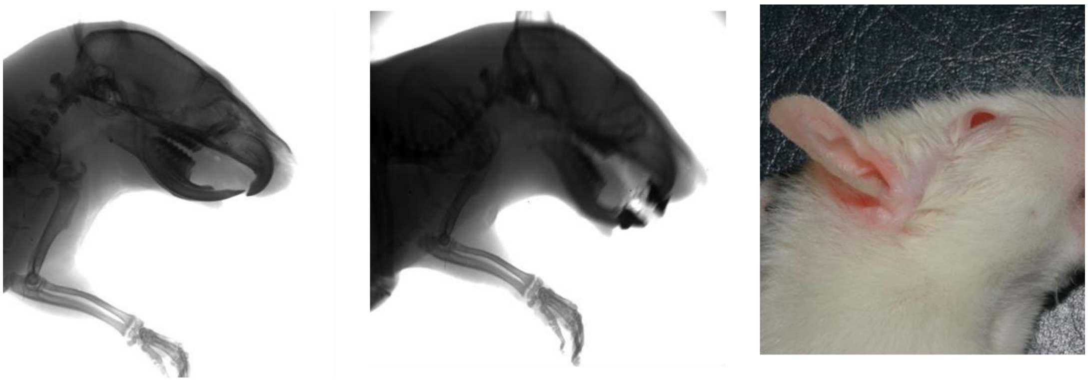
2.4.6 Appliance Design

Rodents have previously been used as an experimental model for studies examining bite-jumping appliances commonly using outbred Sprague-Dawley or Wistar rats (Tonge et al., 1982, Ghafari and Degroote, 1986, Easton and Carlson, 1990, Nicolay et al., 1991, Takahashi et al., 1995, Tsolakis and Spyropoulos, 1997, VandeBerg et al., 2004). The aim for this study was to design an appliance that would achieve mandibular protrusion 24 hours per day, and would allow sufficient function for nutrition and development. The appliance used in this work was based on the work of Xiong *et al*. (2004) at the University of Hong Kong with modifications subsequent to the results of initial pilot work (Xiong et al., 2004) (Figure 6).

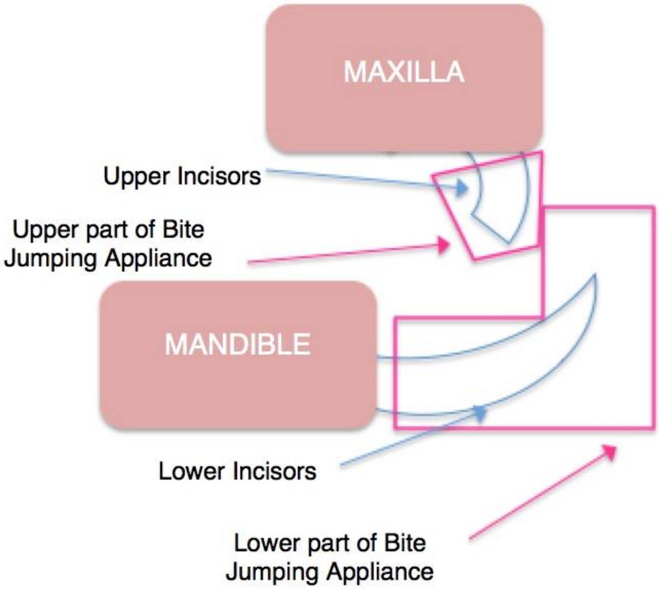
Following pilot trials, it became apparent that the design used by the Hong Kong group required modification. Rodents display a combination of cutting and grinding actions when eating, and their upper and lower incisors continuously erupt throughout life (Weijs and Dantuma, 1975, Luder, 1996). In normal function, incisors are worn down at a similar rate compared with eruption. Steigman reports 443 ± 5 μm per day of eruption with a similar rate of attrition 438 ± 3 μm (Steigman et al., 1989). Other published eruption rates for mandibular incisors of adult rats vary: 2.8 mm per week (Sturman, 1957a), 0.5 mm per day (3.5 mm per week) (Gerlach et al., 2000), 0.67 ± 12 μm per 24 hours (4.67 mm per week) (Shimada et al., 2004). Additionally, incisors continue to erupt, albeit at slightly reduced or accelerated rates regardless of whether they are experimentally loaded or unloaded, respectively, during incisive movements (Steigman et al., 1989). The Hong Kong publications did not mention compensating for this continued incisal growth with respect to their two widely used and incisally cemented mandibular advancement appliance designs, nor are they the only researchers not to do so and nor is the following reference list exhaustive of others who have not (Charlier et al., 1969, Petrovic et al., 1976, Petrovic et al., 1981, Nicolay et al., 1991) (Petrovic et al., 1991, Hajjar et al., 2003). However, there have been other researchers who have considered this issue or the appliances used are somewhat independent of incisor growth (Tonge et al., 1982, Ghafari and Degroote, 1986, Easton and Carlson, 1990, Tsolakis and Spyropoulos, 1997).

While in place, the mandibular advancement appliance developed in the study by Xiong et al. (2004), covers both upper and lower incisors with acrylic and hence normal incisor wear cannot occur. With the appliance impeding incisal wear the upper and lower incisors would have continued to lengthen with normal eruption over time. As the lower incisors elongated over the initial week, the amount of protrusion initially delivered may have potentially decreased as the extra incisor length allowed the protrusive force of the appliance to reduce and the mandibular condyle to return towards the rest position. This potential reduction in protrusion would have been particularly important in the initial stages of appliance wear before posterior occlusal contacts had been achieved, somewhat stabilising the forward position of the mandible (Petrovic et al., 1981). In a 2008 study, Rabie et al. mentioned that he employed two different amounts of advancement: 2 and 4 mm. Taking into account the average rate of growth of lower incisors it is possible that the 2mm advancement group would have lost some or all of the delivered protrusion by the end of the first week, and the protrusion experienced by the 4 mm group would have been significantly reduced (Rabie and Al-Kalaly, 2008). It is possible that the majority of mandibular protrusive force was experienced within the first part of the first week of the protocol and not for the full time period stated in these studies and consequently may have affected experimental results.

The initial pilot work found a modification of the appliance designed by Xiong to be the most reliable (Xiong et al., 2004). During pilot work, the potential problem of loss of protrusion upon mandibular incisor growth was observed on weekly radiographs. To attempt to minimize this effect, the experimental design was revised. The amount of advancement in the bite-jumping appliances used was increased weekly by 2 mm at an increment needed to maintain the initial amount of protrusion relative to the growth of the lower incisors as calculated by the weekly radiograph. Although perhaps this may be considered to be stepwise advancement, it is essentially an attempt to maintain protrusion. Interestingly, although Petrovic did not seem to account for continued incisal growth, he did note that the greatest increase in mandibular length occurred with what he considered to be stepwise advancement (Petrovic et al., 1981). However, it is possible that his 'stepwise' group merely maintained some of the initial protrusion. With this improvement on experimental design it is hoped that this work will contribute valuable information to bite-jumping rodent literature.



a. b. c.



d.

Figure 6: Bite-jumping Appliance Design
a. Lateral cephalometric radiograph; b. Lateral cephalometric radiograph with bite jumping appliance in place; c. Photograph of bite jumping appliance in place; d. schematic diagram of bite jumping appliance. Upper and lower acrylic portions were hand made from dental casts and cemented with Relyx^{TM} Unicem from 3M ESPE to achieve 4mm of advancement (verified radiographically) and 1mm vertical opening. An additional acrylic portion was cemented to the upper plate at the end of each week of appliance wear to maintain the amount of advancement as the incisors continued to erupt.

2.4.7 Cephalometric Analysis

The cephalometric program Viebox 3.1® (dHal Software, Greece) was used to generate digital cephalometric analyses. The centre of the basisphenoid bone, mid-way between the spheno-occipital synchondrosis (SOS), and the presphenoidal-basisphenoidal synchondrosis (PBS), were used as the key registration point (S) representing (0,0) coordinates on x and y-axes (Cleall et al., 1968) in both lateral and dorsoventral tracings. The centre of the basisphenoid bone, mid-way between the endocranial and ectocranial surfaces is tentatively considered to be relatively similar to sella turcica in humans, and a relatively stable registration point (Mortimer, 1937, Spence, 1940, Cleall et al., 1968). The landmarks and variables were based around previous published works relating to rat skeletal morphology and cephalometrics (Cleall et al., 1968, Carter and Harkness, 1995, Bresin and Kiliaridis, 2002, VandeBerg et al., 2004, Xiong et al., 2004).

2.4.7.1 Lateral Cephalometric Analysis

From S point, an x-axis was generated extending through points, SOS and PBS. A y-axis was generated as the perpendicular projection from point S. In addition to specific measurements, landmarks were recorded in terms of x and y coordinates and perpendicular distances from the x and y-axes. These measurements were calculated using Viewbox® 3.1. Where left and right skeletal structures projected a double image, both sides were traced and the mean was used to define the landmark. For details of landmarks used and variables measured (Refer to Table I, Table II, and Figure 7).

Table I: Definitions of Lateral Cephalometric Points

Landmark	Definition
Po	The most posterior superior point on the skull
N	The most anterior point on the nasal bones
E	The intersection of the frontal bone and floor of the anterior cranial fossa
Ba	Basion: the most posterior and inferior point on the occipital condyle
SOS	The mid-point of the sphenooccipital synchondroses
PBS	The mid-point of the presphenoidalbasisphenoidal synchondroses
S	The mid-point of the basisphenoid bone: in the middle of the bone between the endocranial and ectocranial surface, and mid-way between SOS and PBS
Uis	The most anterior and superior point of the premaxillary alveolus
Uii	The most anterior and inferior point on the palatal alveolus of the upper incisor
Lis	The most anterior and superior point of the mandibular alveolus on the lower incisor
Lii	The most anterior and inferior point of the labial alveolus on the lower incisor
Uma	The junction of the alveolar bone and the mesial surface of the first maxillary molar
Ump	The junction of the alveolar bone and the distal surface of the third maxillary molar
Lma	The junction of the alveolar bone and the mesial surface of the first mandibular molar
Lmp	The junction of the alveolar bone and the distal surface of the third mandibular molar
a	The most anterior occlusal point on the first maxillary molar
b	The most anterior occlusal point on the first mandibular molar
c	The most posterior occlusal point on the third maxillary molar
d	The most posterior occlusal point on the third mandibular molar
Co	Condylion: the most posterior superior point on the mandibular condyle
Ar	Articulare: the intersection between the mandible and the sphenoid bone
Go	Gonion: the most posterior point on the angular process of the mandible
Mn	The greatest convexity on the inferior border of the mandibular ramus
Ag	The deepest point of the curvature of the antegonial notch
Dg	The most anterior bony protuberance on the inferior border of the mandible ventral to the attachment of the anterior digastric muscle
R1	Proximal end of radius
R2	Distal end of radius
Planes	**Definition**
X-Axis	The plane through the SOS, S, and PBS
Y-Axis	The plane perpendicular to the X-Axis projected from S point
LOP	Lower Occlusal Plane (through points b and d)
UOP	Upper Occlusal plane (through points a and c)
M-Plane	Mandibular plane though points Go and Dg
P-Plane	Palatal plane through points Uma and Ump

Table II: Definitions of Variables Measured

Variable	Definition
Cranial Linear Measurements	
Anteroposterior	
OSL	Occipital to snout length (Po↔N)
CL	Cranial vault length (Po↔E)
SL	Snout Length (E↔N)
BSL	Basisphenoid length (SOS↔PBS)
Vertical	
PCH	Posterior Cranial Height (Po-Ba)
Maxillary Linear Measurements	
Anteroposterior	
S↔Uii	Maxillary Length
S↔Uma	
Mandibular Linear Measurements	
Anteroposterior	
Go↔Ag	Mandibular ramal length
Go↔Dg	
Go↔Lii	Total length of the lower border of the mandible
Dg↔Lii	
Ag↔Lii	
Co↔Dg	Total length of the mandible excluding dentoalveolar effects
Ar↔Dg	A measure of mandibular protrusion
xCo	Horizontal projection of condylion
Vertical	
Co↔Go	Vertical height of the angular process of the mandible
Co↔Mn	Vertical height of the mandibular ramus
Co↔Ag	Vertical height of mandible at the antegonial notch
yCo	Vertical projection of condylion
Dentoalveolar Measurements	
Anteroposterior	
xUii	Sagittal projection of the most anterior, inferior point on the maxilla palatal to the upper incisors
xUis	Sagittal projection of the most anterior, inferior point on the maxilla labial to the upper incisors
xLii	Sagittal projection of the most anterior, superior point on the mandible, inferior to the lower incisors
xLis	Sagittal projection of the most anterior, superior point on the mandible labial to the lower incisors
xUma	Sagittal projection of the upper molar anterior
xUmp	Sagittal projection of the upper molar posterior
xLma	Sagittal projection of the lower molar anterior
xLmp	Sagittal projection of the lower molar posterior
Uii↔Uma	Distance between upper molars and upper incisors
Lis↔Lma	Distance between lower molars and lower incisors
ADO1	Anterior dentoalveolar overjet: (xUii – xLis)
ADO2	Anterior dentoalveolar overjet: (xUis – xLii)
PDO1	Posterior dentoalveolar overjet: (xUma – xLma)
PDO2	Posterior dentoalveolar overjet: (xUmp – xLmp)

Vertical	
yUis	Vertical projection of the most anterior, superior point on the maxilla palatal to the upper incisors
yUii	Vertical projection of the most anterior, inferior point on the maxilla palatal to the upper incisors
yLii	Vertical projection of the most anterior, inferior point on the mandible, inferior to the lower incisors
yLis	Vertical projection of the most anterior, superior point on the mandible, inferior to the lower incisors
MxAHa	Maxillary alveolar height at 1st molar (yUma)
MxAHp	Maxillary alveolar height at 3rd molar (yUmp)
MdAHa	Mandibular alveolar height at 1st molar (Dg↔Lma)
MdAHp	Mandibular alveolar height at 3rd molar (Ag↔Lmp)
Angular	
MPA	Angle between the cranial base and the mandibular plane
PPA	Angle between the cranial base and the palatal plane
OPA-U	Angle between the cranial base and the occlusal plane upper
OPA-L	Angle between the cranial base and the occlusal plane lower
AoO	Angle of opening (OPA-L – OPA-U)
Measure	
Radius	Length of Radius (R1↔R2)
Weight	Weight of animal at time of radiograph
↔ represents distance between, where x represents the perpendicular distance from the y-axis, and y represents the perpendicular distance from the x-axis.	

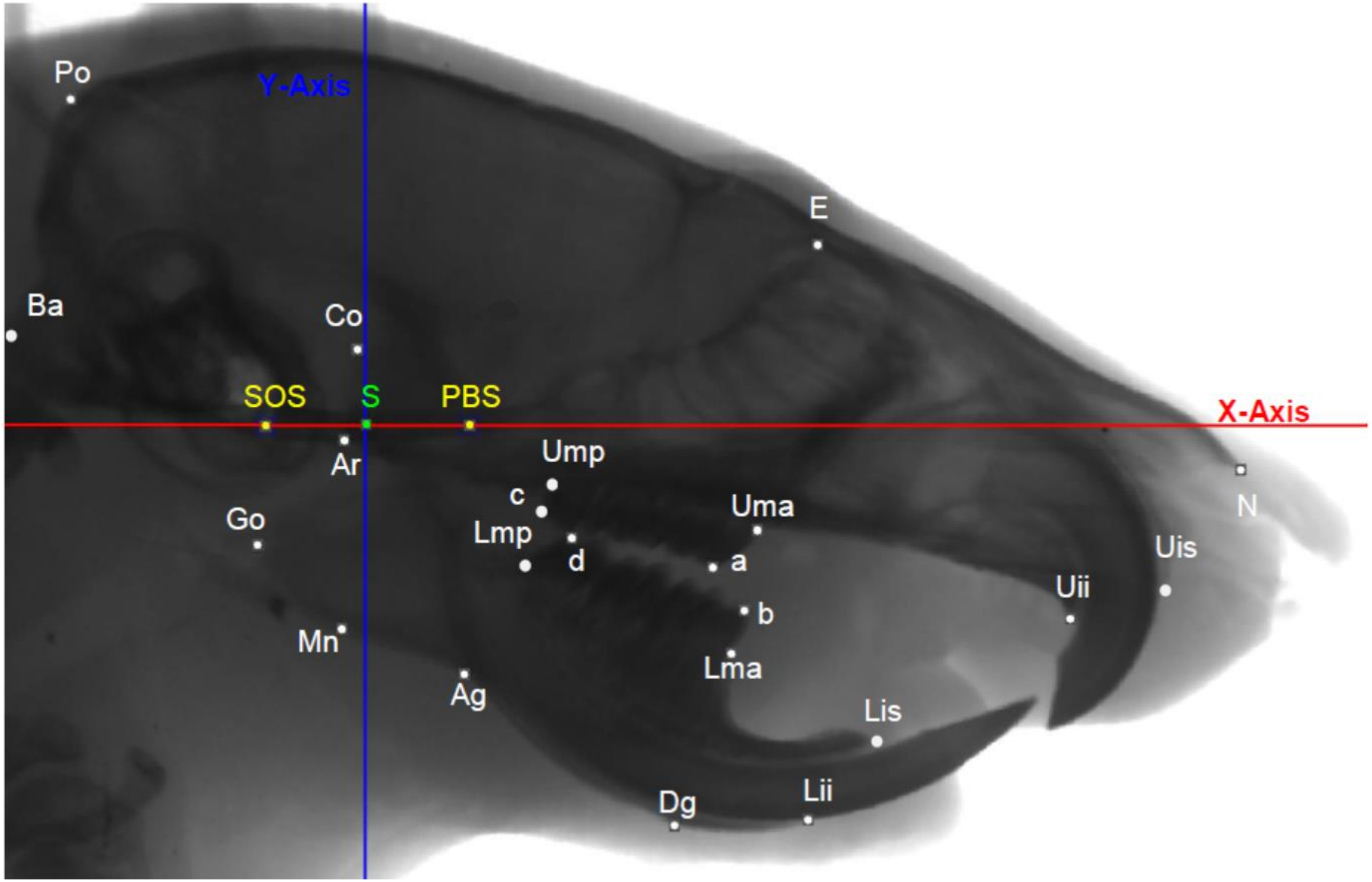


Figure 7: Lateral Cephalometric Points: marked on a radiograph of a 28 day old male Wistar Kyoto rat

2.4.7.2 Dorsoventral Cephalometric Analysis

From S point, an x-axis was generated extending through points, SOS and PBS. A y-axis was generated as the perpendicular projection from point S. In addition to specific variables, landmarks were recorded in terms of x and y coordinates and perpendicular distances from the x and y-axes. These measurements were calculated using Viewbox® 3.1 (Refer to Table III, Table IV and Figure 8).

Table III: Definitions of Dorsoventral Cephalometric Landmarks

Landmark	Definition
O	The most posterior point on the occipital bone
N	The most anterior point at the junction of the nasal bones
SOS	The mid-point of the sphenooccipital synchondrosis
PBS	The mid-point of the presphenoidalbasisphenoidal synchondrosis
S	The mid-point of the basisphenoid bone mid-way between SOS and PBS
Go	The most posterior point on the angular process of the mandible
C	The intersection of the cranium and the Y-Axis
Cd	The most posterior lateral point on the coronoid process
Za	The most anterior point on the frontal process of the maxilla
Zp	The most lateral and posterior point on the curvature of the zygomatic process of the squamosal bone
P	The most anterior and medial point within the temporal fossa that produces the narrowest palatal width
Mx	The junction of the maxilla and premaxilla lateral to the nasolacrimal canal
Planes	**Definition**
X-Axis	The plane through the basisphenoid bone defined by the mid-points of the sphenooccipital and presphenoidal basisphenoidal synchondrosis
Y-Axis	The plane perpendicular to the X-Axis projected from S point
Note: 1 represents the LHS landmark, 2 represents the RHS landmark	

Table IV: Definitions of Dorsoventral Variables Measured

Variable	Definition
Anteroposterior	
O↔N	Occipital to Snout Length
CBL	Cranial Base Length (SOS↔PBS)
Zp1↔Za1	Zygomatic Arch Length 1
Zp2↔Za2	Zygomatic Arch Length 2
xGo1	Sagittal projection of LHS Gonion
xGo2	Sagittal projection of RHS Gonion
xZp1	Sagittal projection of LHS Zp
xZp2	Sagittal projection of RHS Zp
xCd1	Sagittal projection of LHS Cd
xCd2	Sagittal projection of RHS Cd
xP1	Sagittal projection of LHS P
xP2	Sagittal projection of RHS P
xZa1	Sagittal projection of LHS Za
xZa2	Sagittal projection of RHS Za
xMx1	Sagittal projection of LHS Mx
xMx2	Sagittal projection of RHS Mx
xO	Sagittal projection of O
xN	Sagittal projection of N
Transverse	
Go1↔Go2	Intergonial width
C1↔C2	Intercranial width
Zp1↔Zp2	Interzygomatic arch width posterior
Cd1↔Cd2	Intercoronoid process width
P1↔-P2	LHS minus RHS hemi-palatal width
Za1↔Za2	Interzygomatic arch width anterior
Mx1↔Mx2	LHS minus RHS hemi-maxillary width
ND	Snout deviation from the X-Axis
Weight	Weight of animal at time of radiograph
Note: 1 represents the LHS landmark, 2 represents the RHS landmark	

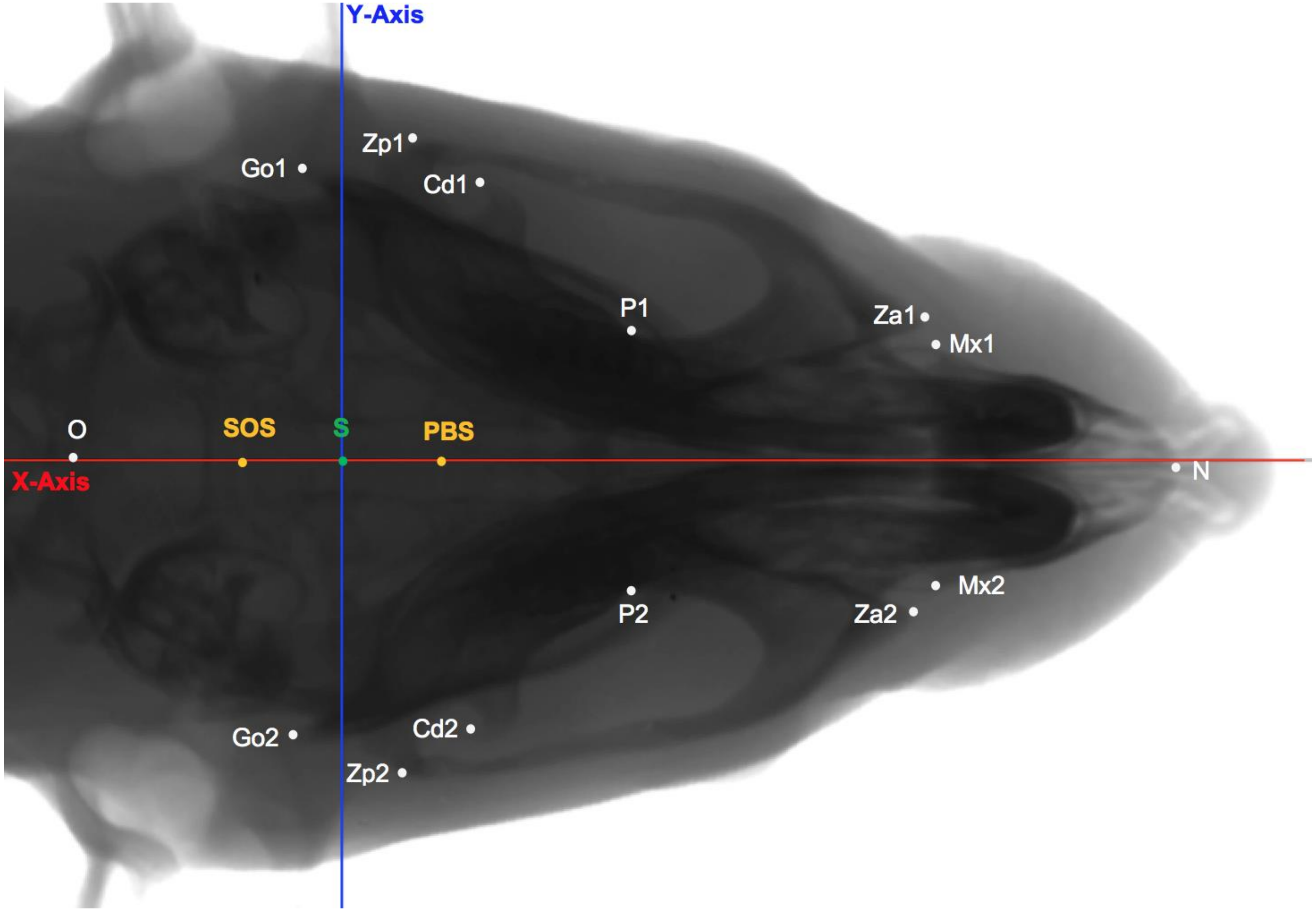


Figure 8: Dorsoventral Cephalometric Landmarks: marked on a radiograph of a 28 day old male Wistar Kyoto rat

3 MATERIALS AND METHODS

3.1 *In Vivo* Work to Obtain Samples

All *in vivo* work was undertaken with prior approval of the animal ethics committee at the University of Queensland, Australia (Appendix 2). One hundred and twenty-eight juvenile (aged 28 days) male inbred Wistar Kyoto (WKY) rats were randomly assigned to sixteen groups (n=8 per group). Groups consisted of: controls; bilateral injection groups using either BoNT/A or saline; bite-jumping appliances only; and bilateral injections using either BoNT/A or saline in combination with bite-jumping appliances (Table V: Experimental Key, and Figure 9: Experimental Design). All procedures were carried out under intraperitoneal general anaesthesia: 0.75mL Ketamine, 0.5mL Xylazine, 0.75mL water for injection (WFI) at 0.1mL per 50 grams of body weight. The animals were housed in high-top cages in a 12 hours light-dark cycle at a temperature of 22° C environment. The animals were uniformly fed an *ad libitum* soft-diet of moistened rat chow mixed with a high calorie, vitamin concentrate to maintain nutrition, Nutrigel® (Ilium, Australia) and weighed daily.

Table V: Experimental Key

Short-term Groups 49 days of age	***Procedures***	**Long-term Groups** 126 days of age	***Procedures***
C	Control	**CL**	Control
B	BoNT/A weekly repeat injections to 49 days	**BL**	BoNT/A weekly repeat injections to 49 days + recovery until 126 days of age
S	Saline weekly repeat injections to 49 days	**BLR**	BoNT/A weekly repeat injections to 126 days
M	Mandibular Appliance to 49 days	**SL**	Saline weekly repeat injections to 49 days + recovery until 126 days of age
MB	Mandibular Appliance to 49 days + BoNT/A weekly repeat injections to 49 days	**SLR**	Saline weekly repeat injections to 126 days
MS	Mandibular Appliance to 49 days + Saline weekly repeat injections to 49 days	**ML**	Mandibular Appliance to 49 days + recovery until 126 days of age.
All subjects were 28 days of age at the beginning of the experimental period. N=8 per Group		**MBL**	Mandibular Appliance to 49 days + BoNT/A weekly repeat injections to 49 days + recovery until 126 days of age
		MBLR	Mandibular Appliance to 49 days + BoNT/A weekly repeat injections to 126 days
		MSL	Mandibular Appliance to 49 days + Saline weekly repeat injections to 49 days + recovery until 126 days of age
		MSLR	Mandibular Appliance to 49 days + Saline weekly repeat injections to 126 days

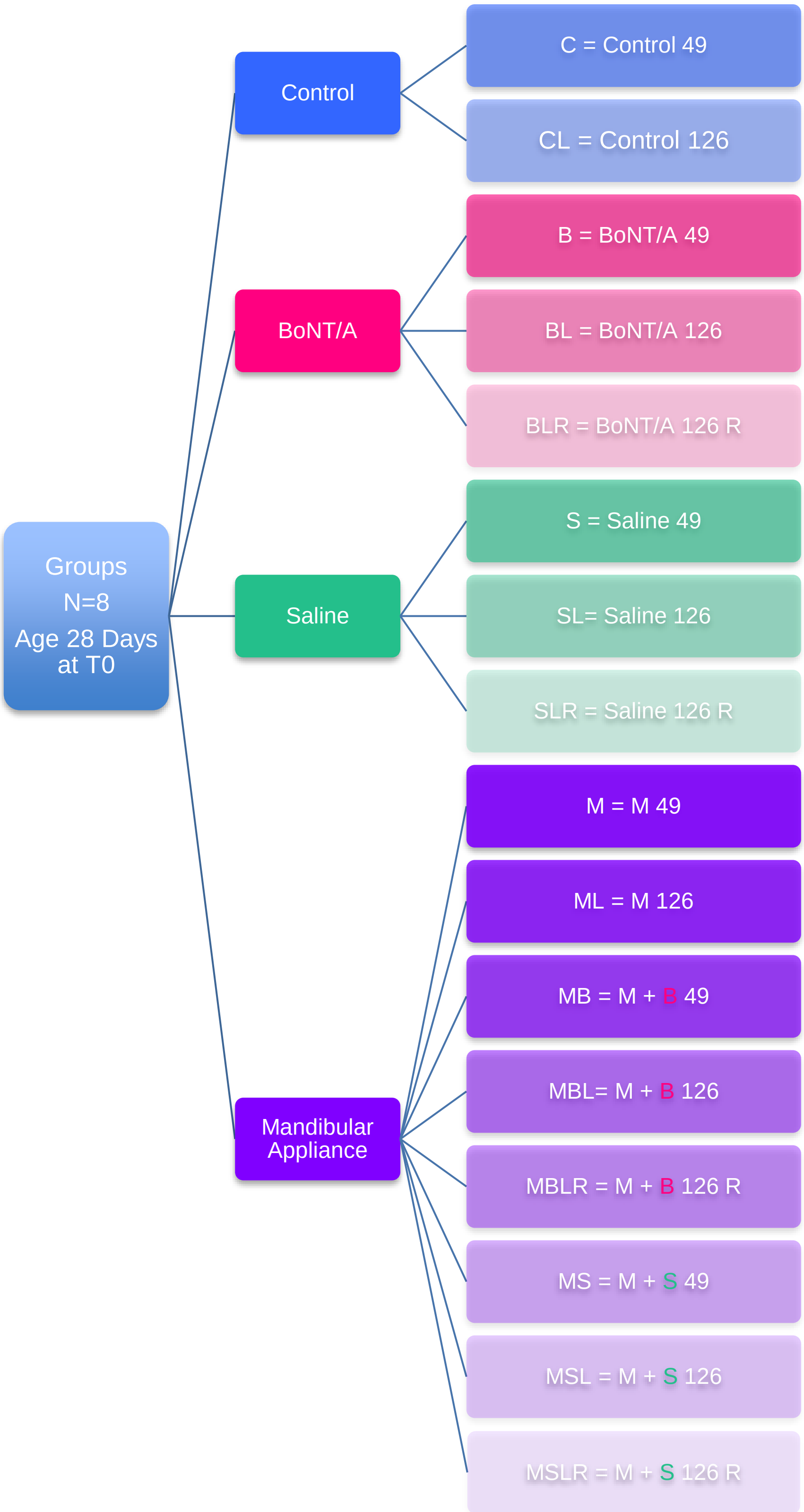
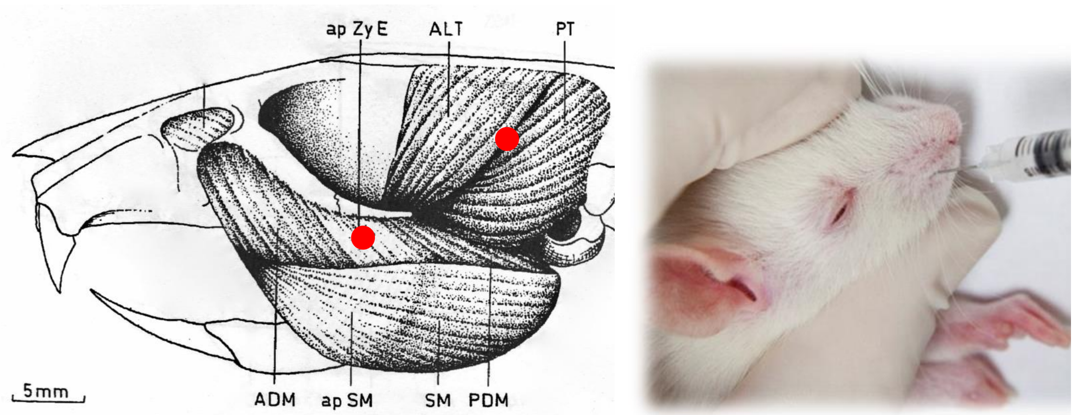


Figure 9: Experimental Design
There were 128 Wistar-Kyoto Rats in Total
Juvenile (49) = 49 days of age; Adult (126) = 126 days of age
C = Control, B = BoNT/A, S = Saline, M = Mandibular Appliance
R = Repeat Injections

The injections were performed using either BoNT/A (Dysport® sodium chloride, lactose, and human serum albumin, 500 U (12.5 ng) per vial, manufactured by Ipsen, UK), or saline ('Sodium Chloride' Injection BP 0.9% 45mg in 5mL manufactured by Pfizer, USA). The anterior lateral and posterior temporalis muscles, and the deep masseter muscles were injected bilaterally with 2 Units per area of Dysport® or an equivalent volume of saline, in the experimental groups, weekly for three weeks using an insulin syringe. BoNT/A was diluted to 500U per 2.5mL of saline (Lowe and Yamauchi, 2004). BoNT/A doses of 2U (total volume 0.01mL) per injection site were used. Sham injections consisted of equivalent volumes of saline. Injections were performed with 29 Gauge (0.33mm x 12.7mm) Ultra-Fine disposable Insulin Syringes depth marked to 1.5 mm, the bevel was faced toward the muscle to attempt to control diffusion of the toxin. The needle was withdrawn 120 seconds later to prevent leakage of the toxin (Franchi et al., 2004). To demonstrate onset and duration of paralysis, the RHS vibrissae, or whisker muscle, was also injected (Franchi and Veronesi, 2004, Franchi, 2002). The temporalis muscle was injected at the palpable junction of the anterior lateral and posterior temporalis muscles, 3 mm superior to a line formed midway between the outer canthus of the eye and the medial aspect of the external auditory meatus. The deep masseter injection was placed 1mm below the zygomatic arch mid-way between the inner and outer canthus of the eye. The vibrissae muscle was injected in the centre of the whisker pad, between the fourth and fifth vibrissa of rows B and C, consistent with previous literature (Franchi, 2002, Franchi and Veronesi, 2004). This voluntary skeletal muscle receives motor innervation via the Facial Nerve (VII), and sensory innervation via the Trigeminal Nerve (V). Vibrissa injection with BoNT/A leads to flattening and immobilization of the whiskers, indicating both onset and duration of paralysis (Figure 10).



a. Masseter and Temporalis Injections b. Vibrissal (whisker muscle) Injection

Figure 10: Injection Technique
Red markings ● indicate site of injections.

The bite jumping appliances were adjusted weekly by adding 2mm of protrusion (cold cure acrylic to the bite blocks) to compensate for the continued growth of rat incisors which would have reduced the protrusive force of the appliance (Weijs and Dantuma, 1975, Luder, 1996). A radiograph was taken to verify the amount of this re-activated protrusion. All bite jumping appliances were removed after 3 weeks of wear when the subjects were 49 days of age which is equivalent to between 12 to 18 months of appliance wear in humans (Quinn, 2005b). The short-term groups were euthanized. For those subjects within the long-term groups, injections were either halted at 49 days of age, or continued weekly until 126 days of age (early adulthood) to examine any differences in skeletal and muscular changes if the muscles were allowed to recover from BoNT/A paralysis or if the paralysis was maintained until adulthood. Pilot work has shown that with BoNT/A injections and bite jumping appliances the incisors over-erupt. The upper and lower incisors were trimmed as needed at each experimental timepoint with Sof-Lex™ discs (3M Unitek, USA) and a slow speed handpiece.

3.2 Radiography

Digital lateral and dorsoventral cephalometric radiographs were taken at multiple timepoints (Figure 11). Radiographs were taken weekly during the first three weeks for all groups, and at further separated intervals after appliance wear and when growth was slowing until adulthood for the long-term groups. The specifications of the Kodak® Molecular Imaging System (FX In Vivo) used were: 35 kVP, 10mA, fixed object to film distance of 60mm, and an exposure time of 1 minute per film. A 10.000 mm ruler initially calibrated with digital calipers served as the magnification guide for each film. Magnification proved to be 10 percent. The data was saved in TIF format. All images were identically converted to JPEG files for transfer to the cephalometric analysis program.

Timepoint	Age in days when radiographs were taken
T0	28 days
T1	35 days
T2	42 days
T3	49 days
T4	56 days
T5	70 days
T6	98 days
T7	126 days
N=8 animals per group. The six short-term groups had xrays at: T0, T1, T2, T3 The ten long-term groups had xrays at: T0, T1, T2, T3, T4, T5, T6, T7 Each appliance group had an additional radiograph at appliance insertion to verify amount of protrusion	

Figure 11: Cephalometric Timepoints

3.4 Radiographic Measurement

The radiographs were measured in random order (to ensure blindness) with the digital cephalometric program, Viewbox® 3.1 (dHal Software, Greece). The magnification ruler was used to ensure that magnification of the images was identical. The digital measurements were transferred to Microsoft Excel® (Microsoft, USA) and then transferred to the statistical software SPSS® (Version 25, IBM Corporation, New York, USA).

3.5 Repeatability Study

With such a large number of variables for both the Lateral and Dorsoventral Cephalometric tracings, a repeatability study was undertaken to examine the reliability of the variables being examined and to reduce the analyses to the most essential and accurate variables (Refer to Chapter 4).

3.6 Statistical Analysis for the Refined List of Variables

Once the refined variables had been defined (Refer to Chapter 4). The statistical software SPSS® software (Version 25, IBM Corporation, New York, U.S.A) was used to run analysis of the measurements obtained from Viewbox® 3.1. One-way ANOVA at each timepoint for the all groups was undertaken followed by the post-hoc analysis, Tamhane. The post-hoc test, Tamhane does not assume constant variance. Significance was set at $p \leq 0.01$ (significant) or $p \leq 0.001$ (highly significant) to elucidate meaningful differences within the results.

4 REPEATABILITY STUDY

4.1 Introduction

4.1.1 Errors of Cephalometric Tracing

While cephalometric tracings are used inherently in orthodontic treatment diagnosis and treatment planning, the errors associated with landmark identification and consequently the errors in the measurement of variables are well documented (Baumrind and Frantz, 1971a, Baumrind and Frantz, 1971b, Ahlqvist et al., 1986, Houston et al., 1986, Battagel, 1993 , Haynes and Chau, 1993). When comparing two or more groups in any study there are several sources of variability: a) between individuals, b) within the same individual, and c) between group differences which represent a real difference between the two measurements.

Errors when measuring may be *Systematic* or *Random*. *Systematic* errors occur when the measurements are recorded as greater or less than the true value due to unknown external factors, for example the radiographic magnification being different and not taken into account, or one observer having a different understanding of landmark identification to another. Lack of blindness when taking measurements can also lead to systematic errors (bias) of the results (Houston, 1983) (Petrie and Sabin, 2009). This study sought to reduce systematic errors by using digital imaging and cephalometric software to achieve identical conditions for obtaining both the radiographs and the measurements. Also, a single blinded operator undertook all digital cephalometric landmark identification. *Random* errors are caused by changes in the experimental conditions, such as variations in in film density (Houston, 1983, Petrie and Sabin, 2009). This study sought to use digital radiography to reduce random errors. The *validity* of a measurement is dictated by random errors and can be determined by repeating the measurements, such as is done within a repeatability study.

In simple terms, *validity* is how accurately the resulting value represents the measurement it was designed to measure (Houston, 1983). *Reliability* refers to how consistent a measure is when undertaken more than once under consistent circumstances. *Reproducibility,* a form of *reliability,* is the extent to which a number of different operators take measurements and produce consistent values under similar conditions (Petrie and Sabin, 2009). *Repeatability* is also a form of *reliability* whereby the measurements are taken by a single operator, on the same object, under the same conditions, and repeated within a short time period (Houston, 1983).

4.1.2 Bland and Altman Diagrams

A Bland and Altman scattergram is a visual representation of the differences between repeated measurements (Bland and Altman, 1986). The Y-axis represents the mean of the differences between two measurements and the X-axis shows the mean of the pairs of measurements. A y-axis value of zero indicates that the measurements are identical. A random scatter of points around the line of zero should be observed if there is no bias and funneling of the data should not be seen. Upper and lower limits within which 95 per cent of the differences lie are displayed and a purple horizontal line shows the mean of the differences. Bland and Altman diagrams also show outliers (Petrie and Sabin, 2009).

4.1.3 Lin's Concordance Correlation Coefficient

Lins concordance correlation coefficient (rho_c) represents how well a second set of measurements compares with an original set of measurements. Or in other words, how far from the line of perfect concordance (the 45 degree line on a scatter plot) the data deviate. A rho_c value of one indicates perfect concordance. While the maximum value of rho_c is one, there are no real standards for determining whether rho_c is poor, moderate, or good. However McBride (2005) suggests the following categories: < 0.90 shows poor concordance, 0.90 to 0.95 shows moderate concordance, 0.96 to 0.99 indicates substantial concordance, and > 0.99 shows near perfect concordance (McBride, 2005).

4.1.4 Paired *t*-test

A paired t-test is used to compare paired measurements and assumes that the subjects have been randomly selected and the differences between paired measurements is normally distributed (Petrie and Sabin, 2009). With respect to landmark identification on radiographs, the test identifies if a significant mean difference between the measurements at two different times in the hopes of identifying operator error; an ideal mean difference would be zero. If the test result is significant, commonly set at $p < 0.05$, this indicates a systematic difference between the repeat readings. With larger numbers of paired t-tests it is advisable to use a lower level of significance such as $p < 0.01$.

4.1.5 British Standards Institution Repeatability Coefficient

The Standard Deviation (SD) is a measure of the dispersion of values around the mean of a sample. The British Standards Institution Repeatability Coefficient (BSIRC) is strictly defined as 1.96 multiplied by the (SD), although 2SD is often used, and represents the maximum difference which is likely to occur between two repeated measurements (Petrie and Sabin, 2009). This value should be considered based on the magnitude of the actual measurement being recorded, for example if the mean of a measurement is 1mm and the BSIRC is 6mm, this may indicate that the variability of this measurement is too large to be acceptable.

4.2 Materials and Methods

The cephalometric analyses used were as per those defined in Chapter 2 (Tables I to IV). Five percent of all radiographs taken of each of the RLC and DVC groups were randomly selected for the repeatability study. One month later landmark identification was repeated by the same operator for the same radiographs and the radiographs were re-measured, again using Viewbox® 3.1. The paired measurements were then subjected to statistical analysis using SPSS® and STATA® (version 13, Stata Corp LLC, UK).

For each variable, statistical analysis was used to generate and determine:

1. Bland and Altman Diagrams
2. Lin's Concordance Correlation Coefficient (rho_c). The guidelines used in this work were as per those provided by McBride (2005) < 0.90 shows poor concordance, 0.90 to 0.95 shows moderate concordance, 0.96 to 0.99 indicates substantial concordance, and >0.99 shows near perfect concordance (McBride, 2005).
3. Paired t-test: significance was set at $p \leq 0.01$ due to the large number of paired t-tests.
4. British Standards Institution Repeatability Coefficient (BSIRC). The values determined were assessed in conjunction with the value of the measurement of the variable when interpreting the results.

The measurements of the variables displayed in Table VII were potentially affected by the upper and lower acrylic appliances cemented to the upper and lower incisors. To determine if the acrylic appliances, although reasonably radiolucent, affected the measurements of these radiographs, the repeatability study was repeated for these relevant variables. As the bite jumping appliances did not obscure landmarks of the DVC radiographs, a repeatability study was not performed on the DVC radiographs with the appliance in place.

4.3 Results

4.3.1 Lateral Cephalometric Repeatability

The Bland and Altman diagrams for the Lateral Cephalometric Repeatability study are displayed in Appendix 3. A random scatter of points was observed for all variables. The Lin's Concordance correlation coefficient (rho_c), the standard deviations of the differences, the British Standards Institution Repeatability Coefficient (BSIRC), and the Paired t-test p values are displayed in Table VI.

Table VI: Lateral Cephalometric Repeatability Results

Variable	Definition	**Lin's Concordance rho_c** *<0.90 poor* ΨΨ 0.90-0.95 moderate Ψ 0.96-0.99 substantial >0.99 ~ perfect	**Standard Deviation (SD)**	**British Standards Repeatability Coefficient (SD x 1.96)**	**Paired t-test p-Value** **sig p ≤ 0.01 *sig p ≤ 0.001
n=21					
Cranial Linear Measurements					
Anteroposterior					
OSL	Occipital to snout length (Po↔N)	0.996	0.241	0.472	0.783
CL	Cranial vault length (Po↔E)	0.889 ΨΨ	0.534	1.05	0.579
SL	Snout Length (E↔N)	0.927 Ψ	0.596	1.168	0.462
BSL	Basisphenoid length (SOS↔PBS)	0.962	0.221	0.433	0.446
Vertical					
PCH	Posterior Cranial Height (Po-Ba)	0.861 ΨΨ	0.341	0.668	0.799
Maxillary Linear Measurements					
Anteroposterior					
S↔Uii	Maxillary Length	0.984	0.342	0.670	0.788
S↔Uma		0.946 Ψ	0.337	0.661	0.131
Mandibular Linear Measurements					
Anteroposterior					
Go↔Ag	Mandibular ramal length	0.986	0.190	0.3724	0.176
Go↔Dg	Distance Go to Dg	0.969	0.611	0.197	0.194
Go↔Lii	Total length of the lower border of the mandible	0.958	0.596	0.168	0.478
Dg↔Lii	Distance Dg to Lii	0.965	0.772	0.513	0.363
Ag↔Lii	Distance Ag to Lii	0.902 Ψ	0.490	0.960	0.754
Co↔Dg	Total length of the mandible excluding dentoalveolar effects	0.954	0.56	0.981	0.978
Ar↔Dg	A measure of mandibular protrusion	0.930 Ψ	0.535	1.050	0.481
xCo	Horizontal projection of condylion	0.901 Ψ	0.431	0.845	0.906
Vertical					
Co↔Go	Vertical height of the angular	0.984	0.199	0.390	0.603

	process of the mandible				
Co↔Mn	Vertical height of the mandibular ramus	0.928 Ψ	0.496	0.972	0.673
Co↔Ag	Vertical height of mandible at the antegonial notch	0.945 Ψ	0.487	0.955	0.470
yCo	Vertical projection of condylion	0.959	0.184	0.361	0.564
Dentoalveolar Measurements					
Anteroposterior					
xUii	Sagittal projection of the most anterior, inferior point on the maxilla palatal to the upper incisors	0.970	0.445	0.872	0.954
xUis	Sagittal projection of the most anterior, inferior point on the maxilla labial to the upper incisors	0.977	0.443	0.868	0.972
xLii	Sagittal projection of the most anterior, superior point on the mandible, inferior to the lower incisors	0.901 Ψ	0.206	0.404	0.843
xLis	Sagittal projection of the most anterior, superior point on the mandible labial to the lower incisors	0.988	0.199	0.39	0.771
xUma	Sagittal projection of the upper molar anterior	0.922 Ψ	0.402	0.788	0.256
xUmp	Sagittal projection of the upper molar posterior	0.981	0.507	0.993	0.475
xLma	Sagittal projection of the lower molar anterior	0.981	0.299	0.586	0.249
xLmp	Sagittal projection of the lower molar posterior	0.725 ΨΨ	1.166	2.285	0.439
Uii↔Uma	Distance between upper molars and upper incisors	0.993	0.114	0.223	0.053
Lis↔Lma	Distance between lower	0.994	0.139	0.272	0.566

	molars and lower incisors				
ADO1	Anterior dentoalveolar overjet: (xUii – xLis)	0.989	0.128	0.251	0.127
ADO2	Anterior dentoalveolar overjet: (xUis – xLii)	0.989	0.152	0.298	0.925
PDO1	Posterior dentoalveolar overjet: (xUma – xLma)	0.982	0.171	0.335	0.217
PDO2	Posterior dentoalveolar overjet: (xUmp – xLmp)	0.818 ΨΨ	1.542	3.022	0.306
Vertical					
yUis		0.766 ΨΨ	0.765	1.499	0.228
yUii	Vertical projection of the most anterior, inferior point on the maxilla palatal to the upper incisors	0.933	2.252	4.413	0.496
yLii	Vertical projection of the most anterior, inferior point on the mandible, inferior to the lower incisors	0.967	1.010	1.979	0.405
yLis	Vertical projection of the most anterior, superior point on the mandible, inferior to the lower incisors	0.901 Ψ	0.612	1.199	0.933
MxAHa	Maxillary alveolar height at 1st molar (yUma)	0.770 ΨΨ	0.389	0.762	0.433
MxAHp	Maxillary alveolar height at 3rd molar (yUmp)	0.742 ΨΨ	0.726	1.422	0.694
MdAHa	Mandibular alveolar height at 1st molar (Dg↔Lma)	0.892 ΨΨ	0.363	0.711	0.319
MdAHp	Mandibular alveolar height at 3rd molar (Ag↔Lmp)	0.867 ΨΨ	0.304	0.596	0.906
Angular					
MPA	Angle between the cranial base and the mandibular plane	0.957	0.285	0.559	0.677
PPA	Angle between the cranial base	0.953	0.276	0.541	0.190

	and the palatal plane				
OPA-U	Angle between the cranial base and the occlusal plane upper	0.989	0.181	0.355	0.204
OPA-L	Angle between the cranial base and the occlusal plane lower	0.989	0.272	0.535	0.927
AoO	Angle of opening (OPA-L – OPA-U)	0.993	0.180	0.333	0.652
Radial Length					
Radius	Length of Radius (R1↔R2)	0.988	0.305	0.598	0.725

4.3.2 Lateral Cephalometric With Appliance Repeatability

The Bland and Altman diagrams for the Lateral Cephalometric with Appliance Repeatability study are displayed in Appendix 3. A random scatter of points was observed for all variables. The Lin's Concordance correlation coefficient (rho_c), the standard deviations of the differences, the British Standards Institution Repeatability Coefficient (BSIRC), and the Paired t-test p values are displayed in Table VII.

Table VII: Results of Repeatability Study for Lateral Cephalometric Radiographs taken with Mandibular Appliances in place

Variable	Definition	Lin's Concordance rho_c *<0.90 poor* Ψ 0.90-0.95 moderate ΨΨ 0.96-0.99 substantial >0.99 ~ perfect	Standard Deviation (SD)	British Standards (SD x 1.96)	Paired t-test p-Value *sig p ≤ 0.01 **sig ≤ 0.001
n=21					
Maxillary Linear Measurements					
Anteroposterior					
S↔Uii	Maxillary Length	0.970	0.180	0.353	0.589
Mandibular Linear Measurements					
Anteroposterior					
Go↔Lii	Total length of the lower border of the mandible	0.99	0.234	0.459	0.589
Dg↔Lii		0.955	0.228	0.447	0.805
Ag↔Lii		0.967	0.218	0.428	0.445
Dentoalveolar Measurements					
Anteroposterior					
xUii	Sagittal projection of the most anterior, inferior point on the maxilla palatal to the upper incisors	0.967	0.192	0.376	0.223
xUis	Sagittal projection of the most anterior, inferior point on the maxilla labial to the upper incisors	0.972	0.176	0.345	0.742
xLii	Sagittal projection of the most anterior, superior point on the mandible, inferior to the lower incisors	0.991	0.227	0.433	0.333
xLis	Sagittal projection of the most anterior, superior	0.989	0.203	0.392	0.068

	point on the mandible labial to the lower incisors				
Uii↔Uma	Distance between upper molars and upper incisors	0.947 Ψ	0.174	0.341	0.268
Lis↔Lma	Distance between lower molars and lower incisors	0.936 Ψ	0.209	0.409	0.904
ADO1	Anterior dentoalveolar overjet: (xUii – xLis)	0.961	0.388	0.760	0.511
ADO2	Anterior dentoalveolar overjet: (xUis – xLii)	0.903 Ψ	0.789	1.546	0.300
Vertical					
yUis		0.756 ΨΨ	0.919	1.801	0.384
yUii	Vertical projection of the most anterior, inferior point on the maxilla palatal to the upper incisors	0.770 ΨΨ	3.03	2.94	0.805
yLii	Vertical projection of the most anterior, inferior point on the mandible, inferior to the lower incisors	0.837 ΨΨ	0.988	1.936	0.086
yLis	Vertical projection of the most anterior, superior point on the mandible, inferior to the lower incisors	0.809 ΨΨ	0.591	1.158	0.762

4.3.3 Dorsoventral Cephalometric Radiographs Repeatability

The Bland and Altman diagrams for the Dorsoventral Cephalometric Repeatability study are displayed in Appendix 3. A random scatter of points was observed for all variables except. The Lin's Concordance correlation coefficient (rho_c), the standard deviations of the differences, the British Institutions Standards Repeatability coefficient (BSIRC), and the Paired t-test p values are displayed in Table VIII.

Table VIII: Dorsoventral Cephalometric Repeatability Results

Variable	**Definition**	**Lin's Concordance rho_c** *<0.90 poor* Ψ 0.90-0.95 moderate ΨΨ 0.96-0.99 substantial >0.99 ~ perfect	**Standard Deviation (SD)**	**British Standards (SD x 1.96)**	**Paired t-test p-Value** *sig p≤ 0.01 **sig p≤ 0.001
n=42					
Anteroposterior					
O↔N	Occipital to Snout Length	0.966	0.161	0.316	0.874
CBL	Cranial Base Length (SOS↔PBS)	0.951	0.147	0.288	0.241
Zp1↔Za1	Zygomatic Arch Length 1	0.981	0.196	0.384	0.917
Zp2↔Za2	Zygomatic Arch Length 2	0.987	0.204	0.399	0.397
xGo1	Sagittal projection of LHS Gonion	0.900 Ψ	0.391	0.766	0.175
xGo2	Sagittal projection of RHS Gonion	0.903 Ψ	0.573	1.123	0.823
xZp1	Sagittal projection of LHS Zp	0.953	0.213	0.417	0.927
xZp2	Sagittal projection of RHS Zp	0.940 Ψ	0.344	0.674	0.107
xCd1	Sagittal projection of LHS Cd	0.934 Ψ	0.361	0.707	0.899
xCd2	Sagittal projection of RHS Cd	0.924 Ψ	0.556	1.089	0.769
xP1	Sagittal projection of LHS P	0.964	0.385	0.755	0.9153
xP2	Sagittal projection of RHS P	0.975	0.402	0.788	0.829
xZa1	Sagittal projection of LHS Za	0.972	0.376	0.737	0.674
xZa2	Sagittal projection of RHS Za	0.980	0.360	0.706	0.524

xMx1	Sagittal projection of LHS Mx	0.968	0.375	0.735	0.080
xMx2	Sagittal projection of RHS Mx	0.982	0.337	0.660	0.844
xO	Sagittal projection of O	0.965	0.335	0.657	0.964
xN	Sagittal projection of N	0.980	0.345	0.676	0.801
Transverse					
Go1↔Go2	Intergonial width	0.939 Ψ	0.164	0.321	0.827
C1↔C2	Intercranial width	0.910 Ψ	0.178	0.308	0.816
Zp1↔Zp2	Interzygomatic arch width posterior	0.986	0.1324	0.243	0.026
Cd1↔Cd2	Intercoronoid process width	0.966	0.121	0.323	0.477
P1↔-P2	Palatal width	0.91 Ψ	0.116	0.227	0.149
Za1↔Za2	Interzygomatic arch width anterior	0.931 Ψ	0.140	0.2744	0.771
Mx1↔Mx2	LHS minus RHS hemi-maxillary width	0.930 Ψ	0.119	0.235	0.388
ND	Snout deviation from the X-Axis	0.865 ΨΨ	0.181	0.355	0.154

4.4 Discussion for Repeatability Study

4.4.1 Lateral Cephalometric Repeatability Study

The Lin's Concordance Coefficient was moderate for incisor variables: SL, S↔UMA, Ag↔Lii,, xCo, yLis, Co↔Mn Co↔AG, xLii, and xUma. The Lins Concordance Coefficient was poor for incisor variables: CL, PCH, PDO2, yUiis, MxAHa, MxAHp, MdHa, MdHp, and xLmp. The paired t-tests for these variables were not significant. All except xCo and Co↔Mn were excluded as these variables were of particular interest to the authors and further results were interpreted with caution.

For those radiographs examined with bite jumping appliances, the Lin's Concordance Coefficient was moderate for variables: xLii, Uii↔Uma, Lis↔Lma, and ADO2. The paired t-tests for these variables were not significance. The decision was made to exclude these variables in the larger study. The Lin's Concordance Coefficient was poor for the vertical variables relating to the incisors: yUis, yUii, yLii, and yLis. This is not surprising as the bite jumping appliance does partially obscure the incisors radiographically. While none of these variables where shown to be systematically different by the paired-t test results, the British Standards Coefficient (BSC), which shows the maximum likely differences between readings, must also be taken into consideration with respect to the magnitude of the measurements themselves. The decision was made to exclude these variables from all further analysis of lateral cephalometric radiographs.

The decision was made to further streamline the analysis and cull variables Dg↔Lii, Co↔Go, Co↔Ag, xUis, xUmp, xLma, xLmp, PDO1, OPA-U, and OPA-L as these variables were not deemed to be as informative for the larger study.

4.4.2 Dorsoventral Cephalometric Repeatability Study

The Lin's Concordance Coefficient was moderate for incisor variables: xGo1, xGo2, xZp2, xCd1, xCd2, Go1↔Go2, C1↔C2, P1↔P2, Za1↔Za2, Mx1↔Mx2, and poor for ND. The paired t-tests for these variables were not significance. The decision was made to include xGo1, xGo2, xCd1, xCd2, Go1↔Go2, C1↔C2, P1↔P2, Za1↔Za2, and Mx1↔Mx2 and interpret the results with caution as the anterior and posterior positions of the coronoid and gonial processes were of interest to the research and the overall widths of the cranium and jaws were an indication of the size of the animals being compared. The decision was made to exclude ND. Additionally, xP1, xP2, xZa1, xZa2, xO, and xN were further excluded as variables were not deemed to be essential based on the null-hypothesis of this work.

4.5 Repeatability Study Outcomes

The refined variables, based on the results of the repeatability study and the decision to be further selective of variables examined on a wider scale, are shown in Tables IX and X. For those variables where the results were borderline acceptable the BSIRC will clearly need to be considered when discussing the results of the larger radiographic analysis in Chapter 5.

Table IX: Refined Lateral Cephalometric Variables

Variable	Definition
Cranial Linear Measurements	
OSL	Occipital to snout length (Po↔N)
BSL	Basisphenoid length (SOS↔PBS)
Maxillary Linear Measurements	
S↔Uii	Distance to maxilla from the middle of the cranial base
Mandibular Linear Measurements	
Go↔Ag	Mandibular ramal length
Go↔Lii	Total length of the lower border of the mandible
Co↔Dg	Total length of the mandible excluding dentoalveolar effects
Ar↔Dg	A measure of mandibular protrusion
xCo	Horizontal projection of condylion
Co↔Mn	Vertical height of the mandibular ramus
yCo	Vertical projection of condylion
Dentoalveolar Measurements	
xUii	Sagittal projection of the most anterior, inferior point on the maxilla palatal to the upper incisors
xLis	Sagittal projection of the most anterior, superior point on the mandible labial to the lower incisors
ADO1	Anterior dentoalveolar overjet: (xUii – xLis)
Angular	
MPA	Angle between the cranial base and the mandibular plane
PPA	Angle between the cranial base and the palatal plane
AoO	Angle of opening (OPA-L – OPA-U)
Measure	
Radius	Length of Radius (R1↔R2)
Weight	Weight of animal at time of radiograph

↔ represents distance between, where x represents the perpendicular distance from the y-axis, and y represents the perpendicular distance from the x-axis.

Table X: Refined Dorsoventral Cephalometric Variables

Variable	Definition
Anteroposterior	
O↔N	Occipital to Snout Length
CBL	Cranial Base Length (SOS↔PBS)
Zp1↔Za1	Zygomatic Arch Length 1
Zp2↔Za2	Zygomatic Arch Length 2
xGo1	Sagittal projection of LHS Gonion
xGo2	Sagittal projection of RHS Gonion
xCd1	Sagittal projection of LHS Cd
xCd2	Sagittal projection of RHS Cd
xMx1	Sagittal projection of LHS Mx
xMx2	Sagittal projection of RHS Mx
Transverse	
Go1↔Go2	Intergonial width
C1↔C2	Intercranial width
Zp1↔Zp2	Interzygomatic arch width posterior
Cd1↔Cd2	Intercoronoid process width
P1↔-P2	LHS minus RHS hemi-palatal width
Za1↔Za2	Interzygomatic arch width anterior
Mx1↔Mx2	LHS minus RHS hemi-maxillary width
Weight	Weight of animal at time of radiograph
Note: 1 represents the LHS landmark, 2 represents the RHS landmark	

5 RESULTS

The cephalometric analyses used were as per those refined in Chapter 3 (Tables IX and X). During the experimental period, no animals were lost from the sample. One hundred percent of the subjects that underwent BoNT/A injections showed RHS whisker paralysis. All subjects within the BoNT/A and appliance groups showed overgrowth of their incisors and these required trimming with a softlex disc and slow-speed handpiece at each radiographic time-point.

Boxplots are used in this work for each variable in each group to display the range of data; depicting the median, quartiles, and extreme values. The box represents the interquartile (IQ) range which contains the middle 50 percent of the measurements. The whiskers are lines that extend from the upper and lower edge of the box to the highest and lowest values which are no greater than 1.5 times the IQ range. A line across the box indicates the median (middle value). Outliers are cases with values between 1.5 and 3 times the IQ range, and hence beyond the whiskers and are marked with a small circle. Extremes outliers are cases with values more than 3 times the IQ range and are marked with a star. The number next to outliers in the boxplots generated by SPSS® statistical software refer to the data identification number to assist in tracking whether a particular subject registered extreme measurements.

5.1 Weight of the Animals

5.1.1 Short-Term Groups Weight

The mean weight of each short-term (ST) group and standard deviation (SD) at each time point are displayed in Table XI and Figures 12 and 13.

Table XI: Weight (W) of the Animals for the ST Groups at each time point (T)

		GROUP					
Time		C	B	S	M	MB	MS
Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001							
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
W (g)	T0	79.00 ± 9.00	60.00 ± 5.00	87.00 ± 5.00	90.00 ± 7.00	82.00 ± 3.00	91.00 ± 6.00
	T1	100.00 ± 4.00	106.00 ± 4.00	115.00 ± 6.00	98.00 ± 8.00	102.00 ± 13.00	94.00 ± 12.00
	T2	114.00± 3.00	93.00 ±7.00	146.00 ± 5.00	109.00 ± 8.00	103.00 ± 12.00	99.00 ± 13.00
	T3	125.00± 5.00	127.00± 8.00	156.00±13.00	114.00± 8.00	120.00 ± 6.00	134.00±10.00

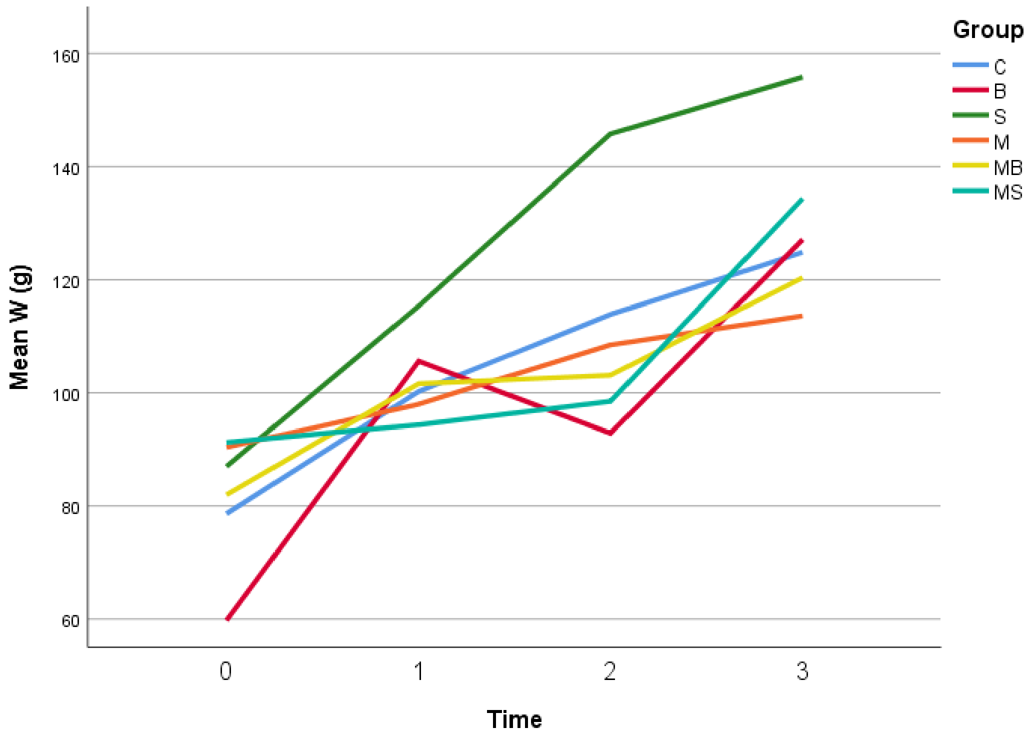


Figure 12: Mean Weight (g) or the ST Groups at each timepoint T0 to T3

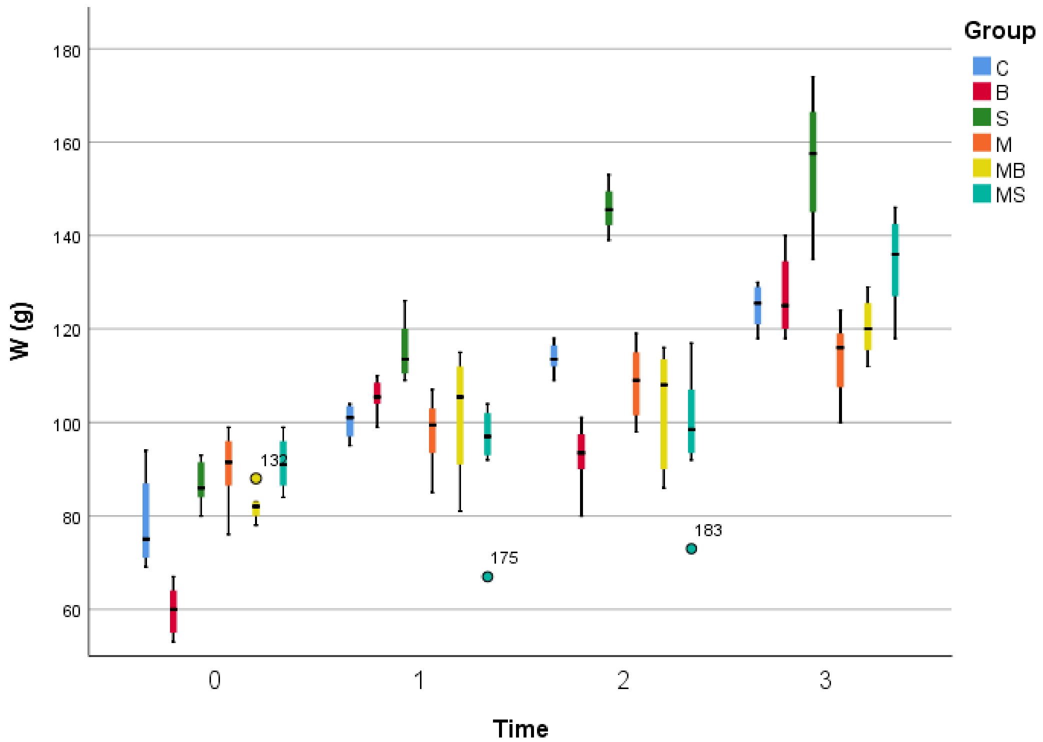


Figure 13: Boxplot of Weight (g) of the ST Groups at each timepoint T0 to T3

At T0 The B group had significantly lower average weight ($p \leq 0.001$) than all other groups. At T1 the S group had significantly higher ($p \leq 0.01$) body weight than both the C and M group. At T2 the S group had significantly higher body weight than all other groups ($p \leq 0.001$). The B group had significantly lower body weight than the C group and M group ($p \leq 0.001$). At T3 the S group had significantly higher body weight than all other groups ($p \leq 0.001$). The B group had significantly higher body weight than the M group ($p \leq 0.01$). The M group had significantly lower body weight than the MS group ($p \leq 0.01$).

In general there was wide variation in weight amongst the short-term groups with the saline group being the heaviest.

5.1.2 Long-Term Groups Weight

The mean weight of each long-term (LT) group and standard deviation (SD) at each time point are displayed in Table XII and Figures 14 and 15.

Table XII: Weight (W) of the Animals for the LT Groups at each time point (T)

Variable		**Group**									
		Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001									
Time		CL	BL	BLR	SL	SLR	ML	MBL	MBLR	MSL	MSLR
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Weight (g)	T0	62.25 13.85	57.75 ± 4.10	63.75 ± 0.19	58.00 ± 3.78	61.63 ± 2.76	75.38 ± 8.62	85.88 ± 1.84	86.13 ± 2.07	87.63 ±13.42	84.13 ± 0.53
	T1	83.25±12.28	72.50 ± 5.43	79.25 ± 1.15	86.00 ± 4.18	86.00 ± 2.83	80.25 ± 8.76	85.88 ± 4.84	94.00 ± 2.07	94.13 ±12.15	94.38 ± 1.25
	T2	109.75±19.22	91.75 ± 6.63	99.13 ± 2.60	103.50 ± 5.61	130.75 ± .26	102.25 ± 7.63	90.88 ± 6.84	106.63 ±7.07	91.75 ± 7.94	105.00 ±2.12
	T3	138.00±20.47	110.13±11.51	99.13 ± 3.60	145.38 ± 7.21	148.50±0.40	120.50 ±11.05	104.88 ±5.84	112.50 ±0.07	100.50 ± 6.12	126.38 ±3.57
	T4	162.63±16.41	122.00 ± 9.73	127.00	172.88 ± 6.40	167.38 ± .70	152.25 ±15.58	117.25 ±7.84	121.75 ±6.07	104.00 ± 3.63	152.38 ±4.65
	T5	221.88±23.78	167.25±18.84	152.38	202.13	196.63 ± .67	165.50 ±13.35	195.75 ±8.84	164.00 ±8.07	126.50 ± 9.67	180.75 ±5.53
	T6	265.63±25.99	211.00±75.61	216.50	244.81	249.00 ± .31	263.86 ±23.72	237.63 ±6.84	249.38 ±6.07	199.75 ±14.56	267.63 ±6.10
	T7	340.00±12.12	294.75±16.70	264.75	328.31	339.38 ± .34	304.38 ±	301.25 ±	298.50 ±	306.38 ±	308.88 ±

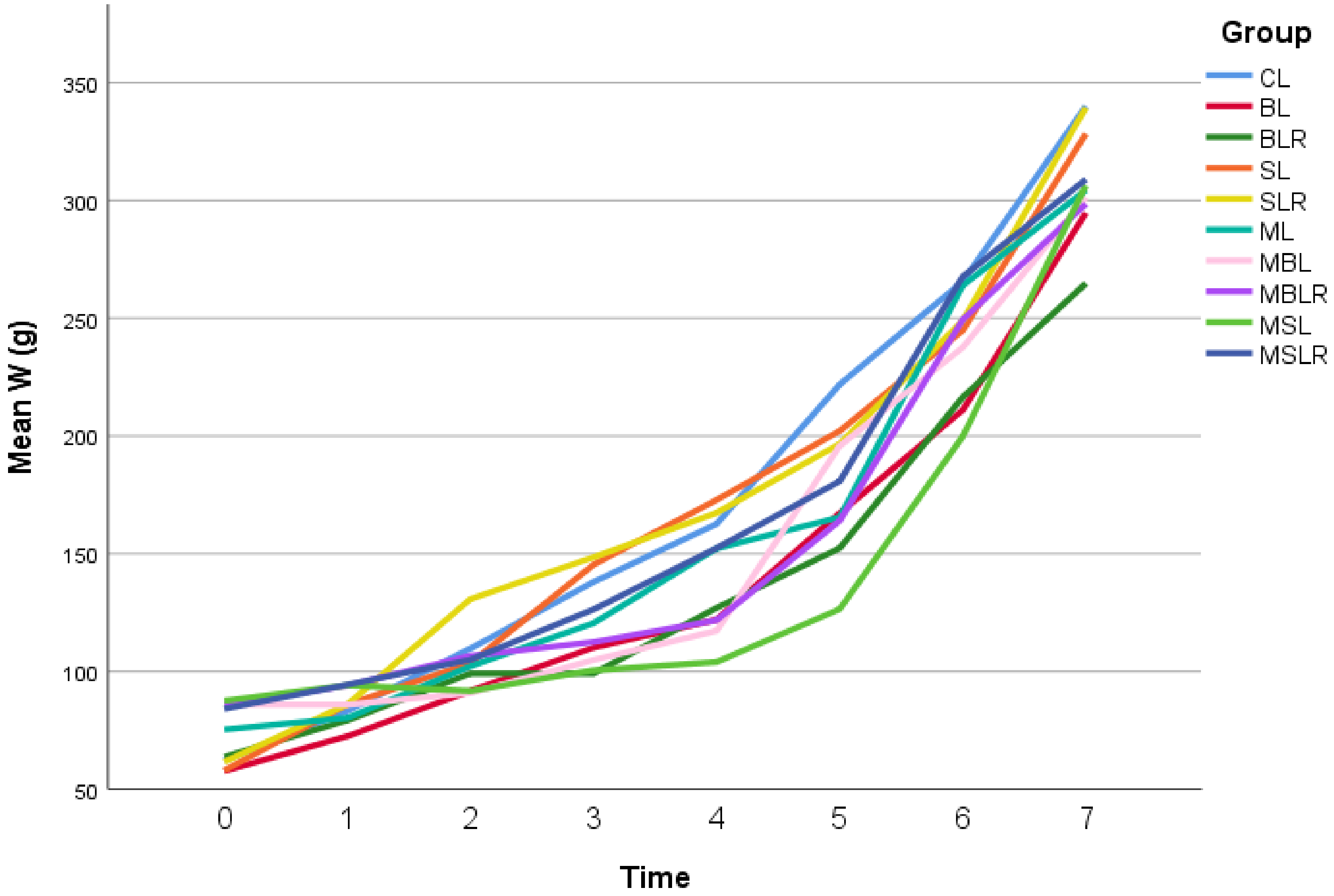


Figure 14: Mean Weight (g) of the Animals for the LT Groups at each timepoint T0 to T7

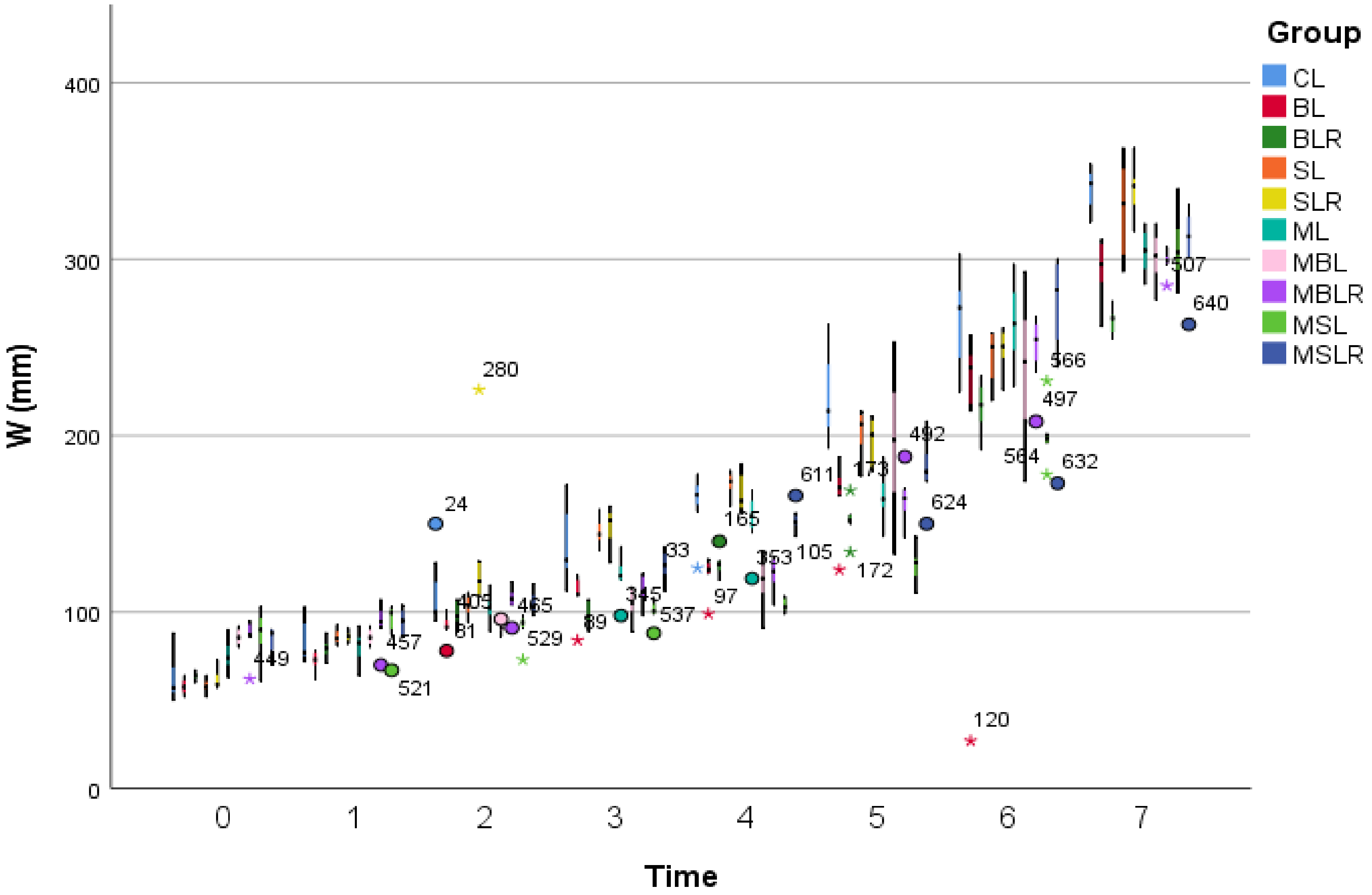


Figure 15: Boxplot of Weight (g) of the LT Groups at each timepoint T0 to T7

At T0 the BL, SL, SLR group had significantly lower weight ($p \leq 0.001$) than MBL, MBLR, MSL, MSLR. The BLR group had significantly lower weight than the MBL, MBLR, and MSLR groups ($p \leq 0.01$). At T1 the BL had significantly lower body weight than groups SL, SLR, MBL, and MSLR ($p \leq 0.01$). At T2 the SLR group had significantly higher body weight than the BL, BLR, and MSL groups ($p \leq 0.01$). At T3 the SL and SLR groups had significantly higher body weight than the BL, BLR, ML, MBL, MBLR, and MSL groups ($p \leq 0.001$). The MSLR group had significantly higher body weight than the BLR group ($p \leq 0.001$). At T4 the CL, SL, and SLR groups had significantly higher body weight than the BL, BLR, ML, MBL, MBLR, and MSL groups ($p \leq 0.01$). At T5 the CL and SL groups had significantly higher body weight than the BL, BLR, ML, MBLR, and MSL ($p \leq 0.01$) groups. The MSL group had a lower body weight than the CL, BL, BLR, SL, SLR, ML, MBLR, and MSLR ($p \leq 0.001$) groups. At T6 the CL and SL groups had significantly higher body weight than the BLR and MSL ($p \leq 0.01$) groups. The MSL group had a lower body weight than the CL, SL, SLR, ML, MBLR, and MSLR ($p \leq 0.01$) groups. At T7 the CL, SL, and SLR groups had significantly higher body weight than the BL, BLR, ML, MBL, and MBLR groups ($p \leq 0.01$). Again there was a wide variation amongst the groups with respect to body weight. The BLR group finished with the lowest overall body weight.

5.2 Lateral Cephalometric Results

5.2.1 Short-Term Groups Lateral Cephalometric Results

The means and standard deviations (SD) for the short-term (ST) Lateral Cephalometric (LC) groups are displayed below in Table XIII. Boxplots for those variables without significant findings or interesting trends can be referred to in Appendix 4.

Table XIII: Means and Standard Deviations for the LC-ST Groups

Variable		Group					
Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001							
Time		C	B	S	M	MB	MS
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
OSL (mm)	T0	33.81± 1.13	34.62 ± 0.41	33.66 ± 1.02	33.66 ± 0.73	34.13 ± 1.21	34.34 ± 1.15
	T1	35.85± 0.84	35.56 ± 0.97	35.59 ± 1.07	34.73 ± 0.45	34.55 ± 1.02	34.60 ± 1.15
	T2	37.20± 0.69	36.50 ± 0.99	36.83 ± 0.82	35.78 ± 0.65	36.03 ± 0.73	35.91 ± 0.64
	T3	37.73± 0.58	36.97 ± 1.37	37.41 ± 0.79	36.44 ± 0.59	36.69 ± 0.57	36.79 ± 0.77
BSL (mm)	T0	4.64± 0.41	4.43 ± 0.26	4.37 ± 0.46	4.47 ± 0.43	5.20 ± 0.45	4.91 ± 0.41
	T1	5.30± 0.50	4.95 ± 0.27	5.19 ± 0.47	5.09 ± 0.50	5.71 ± 0.47	5.30 ± 0.57
	T2	5.70± 0.30	5.49 ± 0.25	5.97 ± 0.27	5.68 ± 0.49	5.98 ± 0.23	5.69 ± 0.23
	T3	6.01± 0.85	5.97 ± 0.38	6.50 ± 0.64	6.10 ± 0.22	6.16 ± 0.71	6.07 ± 0.50
S↔Uii (mm)	T0	20.04± 1.13	20.96 ± 0.65	20.31 ± 0.63	20.30 ± 0.77	20.09 ± 1.07	20.26 ± 1.01
	T1	21.51± 0.95	21.60 ± 1.00	21.61 ± 0.78	20.03 ± 1.06	20.29 ± 0.50	20.30 ± 1.25
	T2	22.31± 0.98	21.82 ± 0.89	22.71 ± 0.65	19.84 ± 0.59	20.67 ± 0.44	20.17 ± 0.70
	T3	22.79± 0.87	22.29 ± 1.62	22.77 ± 1.29	19.85 ± 0.62	21.23 ± 0.51	20.27 ± 0.64
Go↔Ag (mm)	T0	6.99± 0.84	7.37 ± 0.71	7.31 ± 0.98	7.45 ± 0.54	7.51 ± 0.29	7.70 ± 0.76
	T1	8.17± 0.67	7.28 ± 0.66	7.42 ± 0.85	7.08 ± 1.17	6.97 ± 0.75	7.83 ± 1.64
	T2	8.31± 0.66	7.80 ± 0.99	8.61 ± 0.89	7.62 ± 1.18	7.88 ± 1.17	7.31 ± 0.76
	T3	9.02± 0.74	7.90 ± 0.84	8.75 ± 0.34	8.08 ± 1.06	7.85 ± 1.30	7.55 ± 1.23
Go↔Lii (mm)	T0	16.98± 0.66	17.52 ± 0.51	17.41 ± 0.49	17.53 ± 0.54	18.09 ± 0.54	17.94 ± 0.75
	T1	18.34± 0.98	18.24 ± 0.42	17.96 ± 0.76	18.15 ± 0.40	17.79 ± 1.03	18.73 ± 1.38
	T2	19.14± 0.48	18.45 ± 0.80	19.19 ± 0.34	18.39 ± 0.54	18.83 ± 1.14	17.94 ± 1.02
	T3	19.85± 0.40	18.75 ± 0.89	19.79 ± 0.50	18.64 ± 0.68	18.97 ± 0.84	18.97 ± 0.55
Co↔Dg (mm)	T0	16.01± 0.74	16.37 ± 0.83	16.72 ± 0.45	16.40 ± 0.73	16.09 ± 0.56	16.03 ± 0.88
	T1	17.03± 0.84	17.32 ± 0.93	17.42 ± 0.84	17.08 ± 0.97	17.32 ± 0.45	17.45 ± 0.66
	T2	18.29± 0.77	18.20 ± 1.26	17.82 ± 0.99	17.35 ± 0.59	18.14 ± 1.15	17.57 ± 0.92
	T3	18.36± 0.93	18.23 ± 1.13	18.55 ± 0.89	19.05 ± 0.54	19.24 ± 0.45	18.90 ± 0.60
Ar↔Dg (mm)	T0	13.27± 0.55	13.88 ± 0.35	13.71 ± 0.34	13.69 ± 0.37	13.50 ± 0.55	13.34 ± 0.69
	T1	14.31± 0.34	14.37 ± 0.59	14.33 ± 0.42	15.49 ± 0.63	15.50 ± 0.95	15.22 ± 0.58
	T2	15.19± 0.40	15.09 ± 0.29	15.19 ± 0.66	16.31 ± 0.71	16.35 ± 0.56	15.94 ± 0.96
	T3	15.68± 0.47	15.43 ± 0.62	15.59 ± 0.39	16.65 ± 0.65	17.09 ± 0.69	16.30 ± 0.56
xCo (mm)	T0	-0.44± 0.21	-0.54 ± 0.50	-0.45 ± 0.17	-0.42 ± 0.26	0.44 ± 0.27	-0.46 ± 0.21
	T1	-0.47± 0.15	-0.51 ± 0.30	0.33 ± 0.19	-0.46 ± 0.20	0.51 ± 0.24	0.53 ± 0.21
	T2	-0.67± 0.15	-0.47 ± 0.23	0.48 ± 0.17	-0.56 ± 0.23	-0.49 ± 0.18	0.46 ± 0.12
	T3	-0.77± 0.50	-0.37 ± 0.21	0.54 ± 0.25	0.54 ± 0.23	-0.52 ± 0.24	0.26 ± 0.11
Co↔Mn	T0	8.36± 0.79	8.94 ± 0.64	8.40 ± 0.27	8.18 ± 0.75	7.82 ± 0.44	8.08 ± 0.86
	T1	8.81± 0.61	9.05 ± 1.21	9.29 ± 0.34	8.33 ± 0.75	8.32 ± 0.66	7.93 ± 0.83

(mm)	T2	9.56± 0.95	9.31 ± 1.15	9.24 ± 0.50	8.48 ± 0.39	8.51 ± 0.98	8.32 ± 0.70
	T3	9.60± 0.88	9.46 ± 0.94	9.54 ± 0.58	8.63 ± 0.57	8.65 ± 0.94	8.35 ± 1.13
yCo (mm)	T0	2.40± 0.30	2.52 ± 0.30	2.59 ± 0.29	2.39 ± 0.31	2.28 ± 0.36	2.67 ± 0.32
	T1	2.47± 0.35	3.08 ± 0.35	2.92 ± 0.31	2.72 ± 0.48	2.51 ± 0.40	2.65 ± 0.32
	T2	2.91± 0.64	2.92 ± 0.45	2.73 ± 0.45	2.53 ± 0.46	2.46 ± 0.34	2.79 ± 0.61
	T3	2.64± 0.30	3.00 ± 0.39	2.78 ± 0.40	2.56 ± 0.31	2.49 ± 0.24	2.82 ± 0.24
xUii (mm)	T0	19.56± 1.17	19.90 ± 0.77	19.81 ± 0.64	19.89 ± 0.79	19.57 ± 0.98	19.77 ± 1.11
	T1	21.01± 1.05	21.10 ± 0.98	21.00 ± 0.66	19.08 ± 0.88	19.96 ± 0.79	19.18 ± 0.74
	T2	21.45± 0.68	21.13 ± 0.53	21.47 ± 0.55	19.27 ± 0.81	20.06 ± 0.35	19.69 ± 0.57
	T3	22.13± 0.94	21.63 ± 1.57	22.18 ± 1.16	19.74 ± 0.58	20.62 ± 0.29	20.16 ± 0.71
xLis (mm)	T0	14.32 ± 1.15	15.32 ± 0.52	14.81 ± 0.73	14.89 ± 0.66	14.50 ± 0.55	14.64 ± 1.04
	T1	15.53 ± 1.01	15.79 ± 0.88	15.45 ± 0.57	13.85 ± 1.36	14.06 ± 1.37	14.55 ± 2.22
	T2	15.97 ± 0.83	15.68 ± 0.93	16.61 ± 0.65	13.65 ± 1.23	14.48 ± 1.78	13.36 ± 2.13
	T3	16.38 ± 0.95	15.91 ± 1.40	16.35 ± 0.98	14.18 ± 1.27	15.27 ± 2.35	14.18 ± 2.21
ADO1 (mm)	T0	5.24± 0.21	4.58 ± 0.83	5.00 ± 0.15	4.99 ± 0.41	5.07 ± 0.46	5.13 ± 0.23
	T1	5.48± 0.40	5.31 ± 0.47	5.54 ± 0.22	5.10 ± 0.61	5.40 ± 1.49	5.00 ± 1.27
	T2	5.48± 0.68	5.44 ± 0.80	5.61 ± 1.53	5.63 ± 1.45	5.58 ± 2.02	5.71 ± 0.76
	T3	5.75± 0.24	5.72 ± 0.27	5.83 ± 0.29	5.56 ± 1.11	5.98 ± 0.87	5.98 ± 0.82
MPA (°)	T0	9.28± 0.61	9.01 ± 0.87	9.21 ± 0.87	8.36 ± 0.50	8.90 ± 0.49	8.95 ± 0.86
	T1	9.01± 0.62	9.13 ± 0.56	9.17 ± 0.33	13.15 ± 0.46	14.29 ± 0.44	13.43 ± 1.42
	T2	8.87± 0.59	9.65 ± 0.61	8.90 ± 0.32	12.81 ± 1.07	13.22 ± 0.63	12.23 ± 0.80
	T3	9.41± 0.72	9.77 ± 0.64	8.83 ± 0.64	11.85 ± 1.15	13.39 ± 0.89	12.63 ± 0.77
PPA (°)	T0	2.67± 0.66	3.02 ± 0.84	2.57 ± 0.49	2.70 ± 0.42	2.53 ± 0.33	2.60 ± 0.43
	T1	3.09± 0.66	3.36 ± 0.41	2.96 ± 0.61	2.62 ± 0.67	2.37 ± 0.49	3.12 ± 0.56
	T2	3.02± 0.51	2.26 ± 0.70	2.33 ± 0.62	2.42 ± 0.75	2.82 ± 0.57	3.12 ± 0.76
	T3	2.22± 0.46	2.99 ± 0.61	2.84 ± 0.62	2.85 ± 0.66	2.59 ± 0.39	2.45 ± 0.30
AoO (°)	T0	1.58± 0.75	1.36 ± 0.29	1.49 ± 0.23	1.62 ± 0.78	1.10 ± 0.38	1.47 ± 0.74
	T1	1.93± 0.44	1.21 ± 1.14	1.14 ± 0.51	6.48 ± 1.50	6.95 ± 1.23	6.98 ± 1.10
	T2	1.64± 1.19	1.88 ± 1.16	1.47 ± 0.48	5.27 ± 1.30	6.18 ± 0.71	4.81 ± 1.05
	T3	1.74± 0.72	1.48 ± 0.39	1.37 ± 0.36	3.63 ± 0.95	5.68 ± 1.42	4.83 ± 0.57
Radius (mm)	T0	14.15 ± 1.15	14.96 ± 0.40	14.71 ± 0.68	14.64 ± 0.45	14.87 ± 0.49	14.81 ± 1.02
	T1	15.85 ± 0.66	15.63 ± 0.94	16.09 ± 0.30	15.23 ± 0.45	15.33 ± 0.70	15.62 ± 0.84
	T2	17.22 ± 0.53	16.83 ± 0.90	17.00 ± 0.27	16.07 ± 0.46	16.30 ± 0.45	16.20 ± 0.72
	T3	17.54 ± 0.45	17.13 ± 0.98	17.83 ± 0.30	16.17 ± 0.76	16.50 ± 0.42	16.48 ± 0.64

5.2.1.1 LC-ST Anteroposterior Position of Maxilla from the Cranial Base (S to Uii)

Multiple comparisons within the groups between T0, T1, and T3 for S↔Uii are displayed below (Table XIV). A line graph of the group means and a boxplot of S↔Uii are displayed below in Figures 16 and 17. There were no significant differences for S↔Uii at T0 and T1. At T2 the M group had a significantly shorter S↔Uii length than the C and S groups ($p \leq 0.001$) and the B group ($p \leq 0.01$). The MS group had a significantly shorter S↔Uii length than the C and S groups ($p \leq 0.001$). At T3 the M group had a significantly shorter S↔Uii length than the C and S groups ($p \leq 0.001$) and the MB group ($p \leq 0.01$). The MS group had a significantly shorter S↔Uii length than the C and S groups ($p \leq 0.001$).

Table XIV: Multiple Comparisons Within Groups LC-ST for S to Uii

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-1.47	0.52	0.08	-3.51	0.57
		2	-2.27*	0.53	0.01	-4.33	-0.21
		3	-2.74*	0.51	0.00	-4.74	-0.76
	1	2	-0.80	0.48	0.53	-2.67	1.07
		3	-1.28	0.46	0.08	-3.05	0.50
	2	3	-0.48	0.46	0.90	-2.27	1.32
B	0	1	-0.64	0.42	0.63	-2.33	1.05
		2	-0.86	0.39	0.24	-2.40	0.67
		3	-1.33	0.62	0.30	-4.03	1.36
	1	2	-0.22	0.47	1.00	-2.05	1.61
		3	-0.69	0.67	0.90	-3.42	2.04
	2	3	-0.47	0.65	0.98	-3.17	2.23
S	0	1	-1.29	0.35	0.02	-2.68	0.10
		2	-2.39*	0.32	0.00	-3.64	-1.15
		3	-2.45*	0.51	0.00	-4.61	-0.30
	1	2	-1.10	0.36	0.05	-2.50	0.29
		3	-1.17	0.53	0.27	-3.34	1.01
	2	3	-0.06	0.51	1.00	-2.22	2.09
M	0	1	0.27	0.46	0.99	-1.57	2.11
		2	0.46	0.34	0.75	-0.89	1.81
		3	0.45	0.35	0.78	-0.92	1.82
	1	2	0.19	0.43	1.00	-1.58	1.97
		3	0.18	0.43	1.00	-1.60	1.96
	2	3	-0.01	0.30	1.00	-1.18	1.16
MB	0	1	-0.20	0.42	1.00	-1.98	1.58
		2	-0.58	0.41	0.71	-2.36	1.20
		3	-1.14	0.42	0.12	-2.92	0.64
	1	2	-0.38	0.24	0.56	-1.30	0.53
		3	-0.94*	0.25	0.01	-1.92	0.04
	2	3	-0.56	0.24	0.19	-1.49	0.37
MS	0	1	-0.04	0.57	1.00	-2.26	2.18
		2	0.09	0.43	1.00	-1.64	1.82
		3	-0.01	0.42	1.00	-1.72	1.70
	1	2	0.13	0.50	1.00	-1.95	2.22
		3	0.03	0.49	1.00	-2.05	2.11
	2	3	-0.10	0.33	1.00	-1.40	1.20

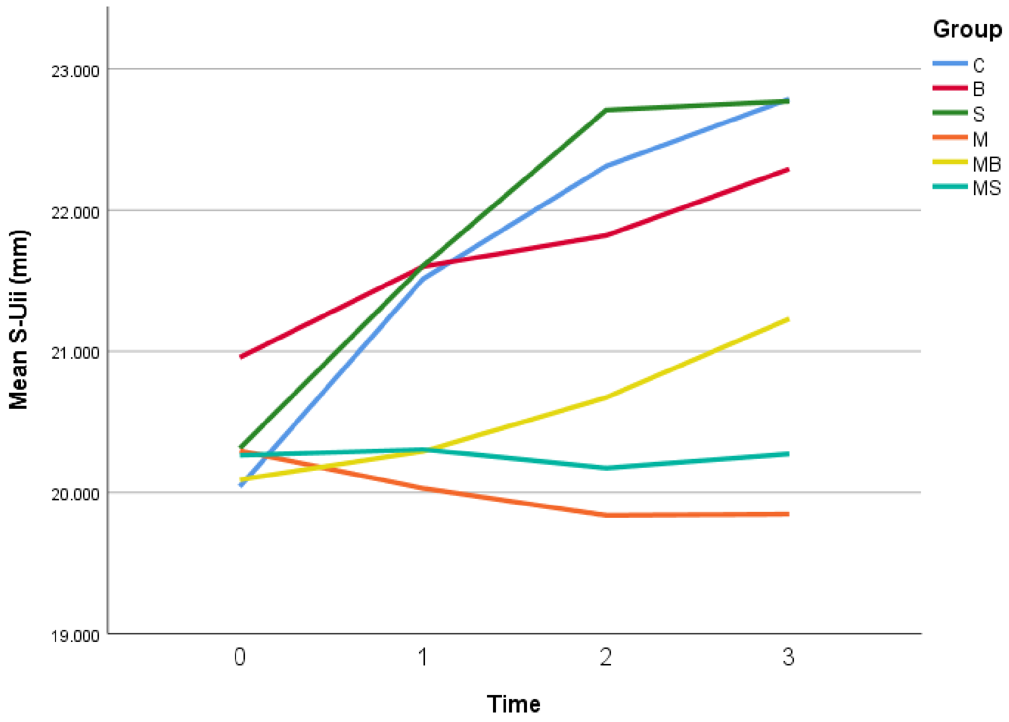


Figure 16: Line Graph of Means of S↔Uii (mm) for LC-ST Groups from T0 to T3

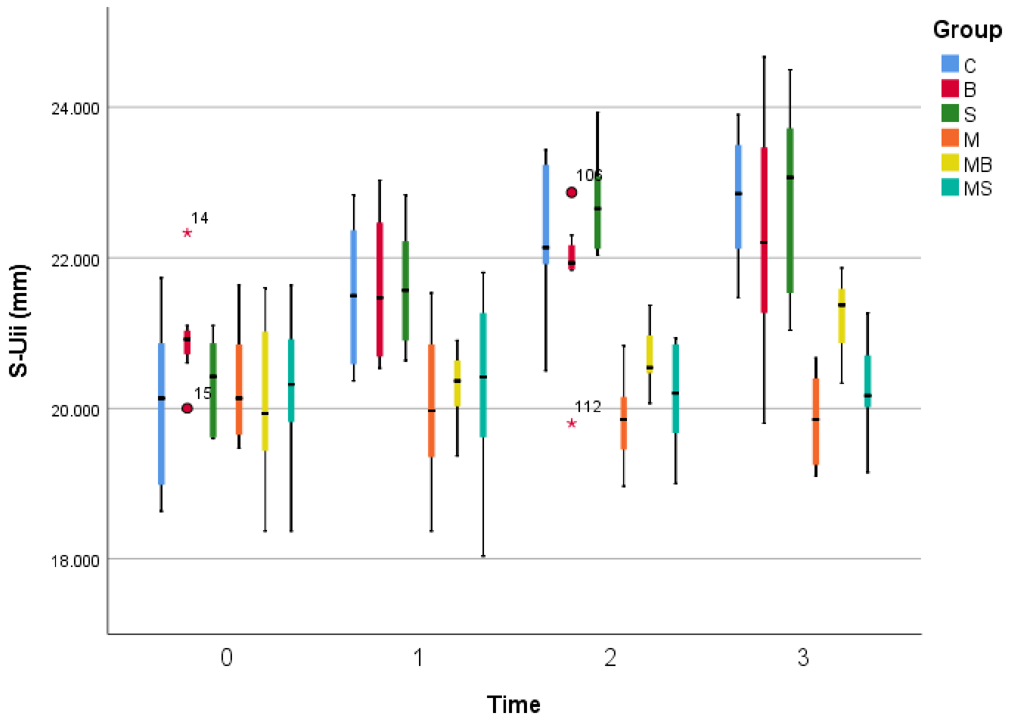


Figure 17: Boxplot of S↔Uii (mm) for LC-ST Groups from T0 to T3

5.2.1.2 LC-LT Total Length of Mandible (Co to Dg)

Multiple comparisons within the groups between T0, T1, and T3 for Co↔Dg are displayed below (Table XV). A line graph of the group means and a boxplot of Co↔Dg are displayed below in Figures 18 and 19. It is apparent from the results that by T3 the MBL group had a longer Co↔Dg length however this result was not significant.

Table XV: Multiple Comparisons Within Groups LC-ST for Co↔Dg

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-1.02	0.40	0.13	-2.57	0.52
		2	-2.27*	0.38	0.00	-3.75	-0.81
		3	-2.34*	0.42	0.00	-3.99	-0.70
	1	2	-1.26	0.40	0.05	-2.83	0.31
		3	-1.33	0.44	0.06	-3.05	0.40
	2	3	-0.07	0.43	1.00	-1.73	1.60
B	0	1	-0.95	0.44	0.27	-2.66	0.77
		2	-1.83	0.53	0.03	-3.96	0.31
		3	-1.86	0.50	0.02	-3.82	0.11
	1	2	-0.88	0.55	0.58	-3.06	1.31
		3	-0.91	0.52	0.48	-2.94	1.12
	2	3	-0.03	0.60	1.00	-2.35	2.30
S	0	1	-0.70	0.34	0.33	-2.11	0.71
		2	-1.10	0.38	0.10	-2.75	0.54
		3	-1.82*	0.35	0.00	-3.31	-0.35
	1	2	-0.40	0.46	0.95	-2.20	1.39
		3	-1.13	0.43	0.12	-2.81	0.55
	2	3	-0.72	0.47	0.61	-2.55	1.10
M	0	1	-0.68	0.43	0.59	-2.37	1.01
		2	-0.95	0.33	0.08	-2.25	0.35
		3	-2.65*	0.32	0.00	-3.93	-1.38
	1	2	-0.27	0.40	0.99	-1.90	1.36
		3	-1.97*	0.39	0.00	-3.60	-0.36
	2	3	-1.70*	0.28	0.00	-2.81	-0.61
MB	0	1	-1.22*	0.25	0.00	-2.22	-0.23
		2	-2.04*	0.45	0.01	-3.97	-0.13
		3	-3.15*	0.25	0.00	-4.14	-2.16
	1	2	-0.82	0.44	0.44	-2.75	1.10
		3	-1.92*	0.22	0.00	-2.80	-1.06
	2	3	-1.11	0.44	0.18	-3.03	0.82
MS	0	1	-1.42	0.39	0.02	-2.95	0.11
		2	-1.54	0.45	0.02	-3.28	0.20
		3	-2.87*	0.38	0.00	-4.37	-1.37
	1	2	-0.12	0.40	1.00	-1.70	1.47
		3	-1.45*	0.32	0.00	-2.68	-0.23
	2	3	-1.34	0.39	0.03	-2.90	0.23

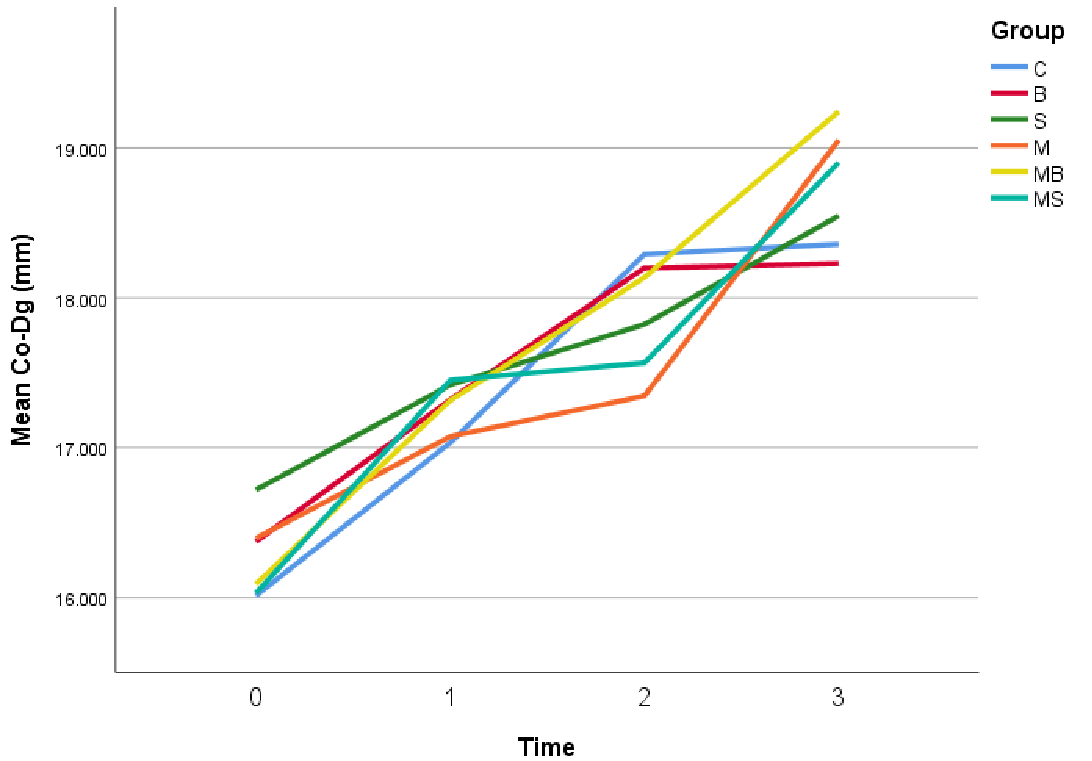


Figure 18: Line Graph of Mean Co↔Dg (mm) LC-ST groups from T0 to T3

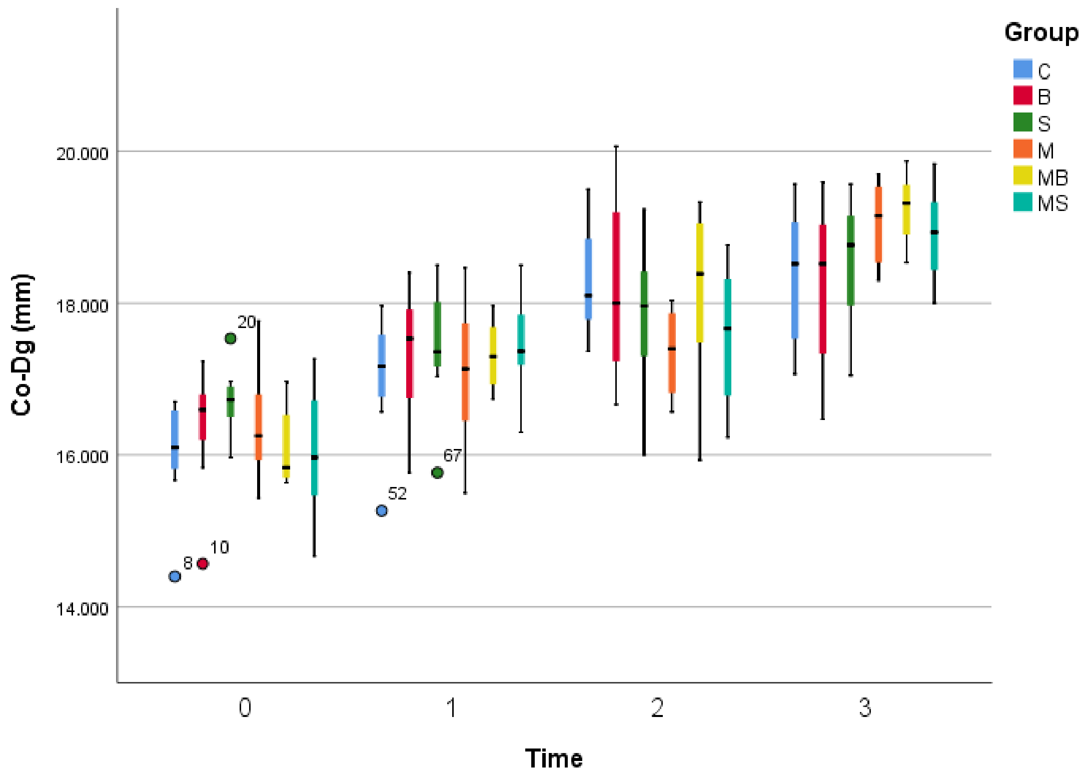


Figure 19: Boxplot of Co↔Dg (mm) for the LC-ST Groups at T0 to T3

5.2.1.3 LC-ST Articulare to Dg

Multiple comparisons within the groups between T0, T1, and T3 for Ar↔Dg are displayed below (Table XVI). A line graph of the group means and a boxplot of Ar↔Dg are displayed below in Figures 20 and 21. There were no significant differences between the groups at T0. While the means Ar↔Dg lengths were greater in the M, MB, and MS groups at T1, they were not significantly longer. At T2 the MB group had a significantly increased Ar↔Dg length than the C and B groups ($p \le 0.01$). At T3 the MB group had a significantly increased Ar↔Dg length than the C, B and S groups ($p \le 0.01$).

Table XVI: Multiple Comparisons Within Groups LC-ST for Ar↔Dg

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \le 0.01$ or $p \le 0.001$						Lower	Upper
C	0	1	-1.04*	0.23	0.00	-1.97	-0.12
		2	-1.92*	0.24	0.00	-2.88	-0.97
		3	-2.40*	0.26	0.00	-3.41	-1.41
	1	2	-0.87*	0.19	0.00	-1.60	-0.15
		3	-1.36*	0.21	0.00	-2.18	-0.55
	2	3	-0.49	0.22	0.24	-1.35	0.37
B	0	1	-0.49	0.24	0.33	-1.48	0.50
		2	-1.21*	0.16	0.00	-1.84	-0.59
		3	-1.55*	0.25	0.00	-2.60	-0.52
	1	2	-0.72	0.23	0.06	-1.70	0.26
		3	-1.06	0.30	0.02	-2.24	0.11
	2	3	-0.34	0.24	0.72	-1.38	0.69
S	0	1	-0.63	0.19	0.04	-1.38	0.13
		2	-1.48*	0.26	0.00	-2.58	-0.39
		3	-1.88*	0.18	0.00	-2.59	-1.17
	1	2	-0.86	0.28	0.05	-1.97	0.25
		3	-1.25*	0.20	0.00	-2.04	-0.47
	2	3	-0.39	0.27	0.68	-1.49	0.71
M	0	1	-1.80*	0.26	0.00	-2.86	-0.74
		2	-2.62*	0.28	0.00	-3.80	-1.44
		3	-2.95*	0.27	0.00	-4.05	-1.87
	1	2	-0.82	0.34	0.16	-2.13	0.48
		3	-1.16	0.32	0.02	-2.40	0.08
	2	3	-0.34	0.34	0.92	-1.66	0.98
MB	0	1	-2.00*	0.39	0.00	-3.59	-0.41
		2	-2.84*	0.28	0.00	-3.93	-1.77
		3	-3.58*	0.31	0.00	-4.81	-2.36
	1	2	-0.85	0.39	0.27	-2.44	0.74
		3	-1.58	0.41	0.01	-3.22	0.06
	2	3	-0.74	0.31	0.19	-1.96	0.49
MS	0	1	-1.87*	0.32	0.00	-3.12	-0.63
		2	-2.59*	0.42	0.00	-4.26	-0.94
		3	-2.96*	0.31	0.00	-4.19	-1.73
	1	2	-0.72	0.40	0.45	-2.34	0.89
		3	-1.09*	0.29	0.01	-2.20	0.03
	2	3	-0.36	0.39	0.94	-1.97	1.25

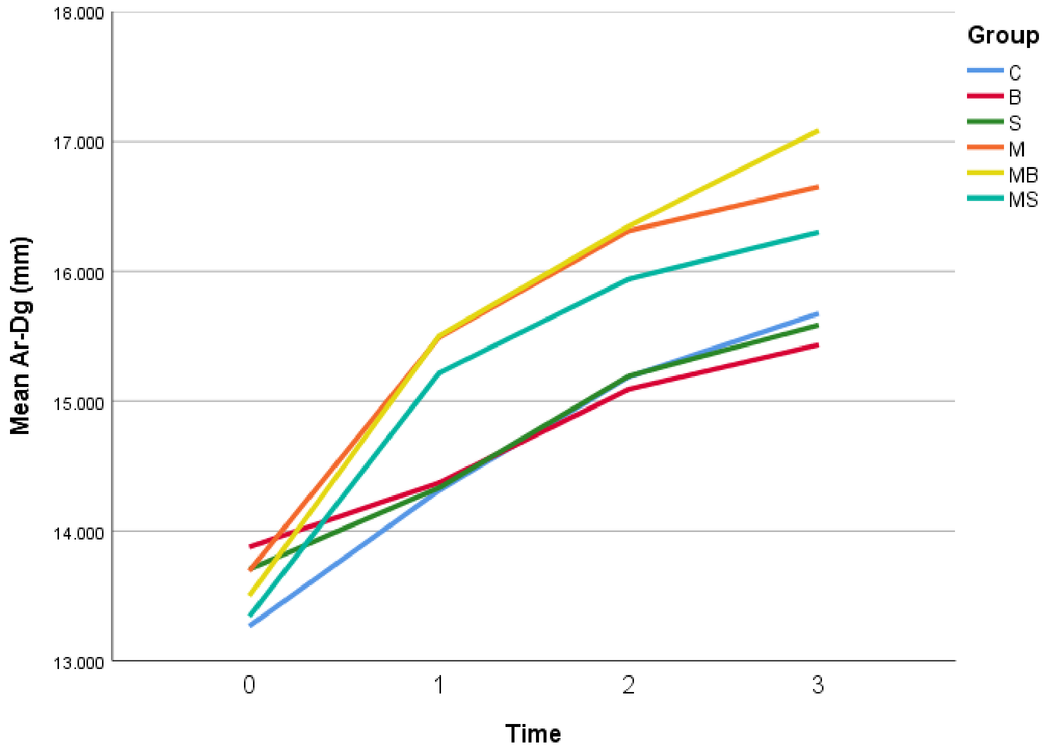


Figure 20: Line Graph of mean Ar↔Dg (mm) for the LC-ST Groups at T0 to T3

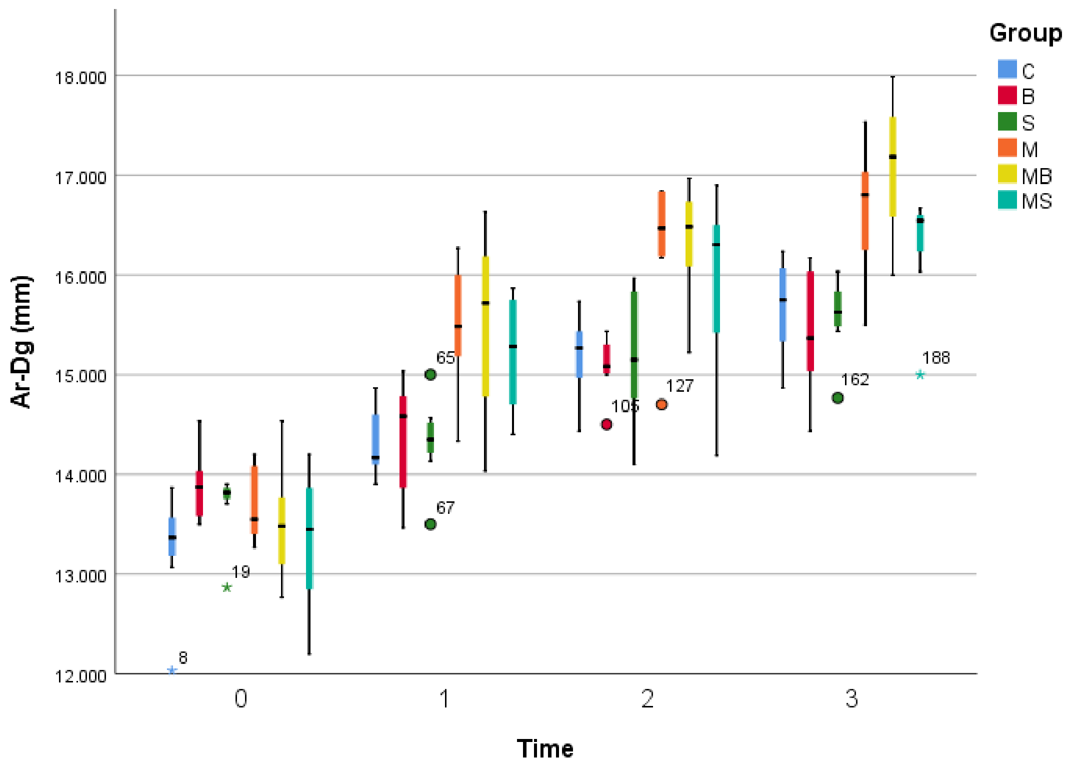


Figure 21: Boxplot of Ar↔Dg (mm) for the LC-ST Groups at T0 to T3

5.2.1.4 LC-ST xCo

Multiple comparisons within the groups between T0, T1, and T3 for xCo are displayed below (Table XVII). A line graph of the group means and a boxplot of xCo are displayed below in Figures 22 and 23. At T0 there were no significant differences in the horizontal projection of xCo between the groups. At T1, T2, and T3 the M, MB, and MS groups had significantly more anteriorly positioned condyles than the C, B, and S groups ($p \leq 0.001$).

Table XVII: Multiple Comparisons Within Groups LC-ST for xCo

Group	Time	Time	Mean	Std. Error	Sig.	99% Confidence Interval	
*The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower Bound	Upper Bound
C	0	1	0.04	0.09	1.00	-0.33	0.40
		2	0.23	0.09	0.16	-0.14	0.60
		3	0.33	0.19	0.54	-0.51	1.17
	1	2	0.19	0.07	0.12	-0.10	0.48
		3	0.29	0.19	0.63	-0.56	1.14
	2	3	0.10	0.19	1.00	-0.75	0.95
B	0	1	-0.02	0.20	1.00	-0.86	0.81
		2	-0.07	0.19	1.00	-0.89	0.76
	1	2	-0.04	0.13	1.00	-0.57	0.48
		3	-0.14	0.13	0.87	-0.66	0.37
	2	3	-0.10	0.11	0.95	-0.53	0.33
S	0	1	-.78*	0.09	0.00	-1.14	-0.42
		2	-.93*	0.09	0.00	-1.26	-0.60
		3	-.98*	0.11	0.00	-1.42	-0.56
	1	2	-0.15	0.09	0.55	-0.50	0.20
		3	-0.21	0.11	0.42	-0.65	0.23
	2	3	-0.06	0.11	1.00	-0.49	0.37
M	0	1	0.04	0.12	1.00	-0.42	0.50
		2	0.14	0.12	0.84	-0.33	0.62
		3	-0.95*	0.12	0.00	-1.43	-0.48
	1	2	0.10	0.11	0.93	-0.32	0.52
		3	-0.99*	0.11	0.00	-1.42	-0.58
	2	3	-1.09*	0.11	0.00	-1.54	-0.66
MB	0	1	-0.08	0.13	0.99	-0.57	0.42
		2	0.92*	0.11	0.00	0.46	1.38
		3	0.95*	0.13	0.00	0.46	1.45
	1	2	0.99*	0.11	0.00	0.58	1.42
		3	1.02*	0.12	0.00	0.57	1.49
	2	3	0.03	0.11	1.00	-0.39	0.45
MS	0	1	-0.99*	0.11	0.00	-1.40	-0.58
		2	-0.91*	0.09	0.00	-1.27	-0.57
		3	-0.71*	0.08	0.00	-1.06	-0.37
	1	2	0.07	0.09	0.96	-0.28	0.43
		3	0.28	0.09	0.05	-0.08	0.63
	2	3	0.20	0.06	0.02	-0.02	0.43

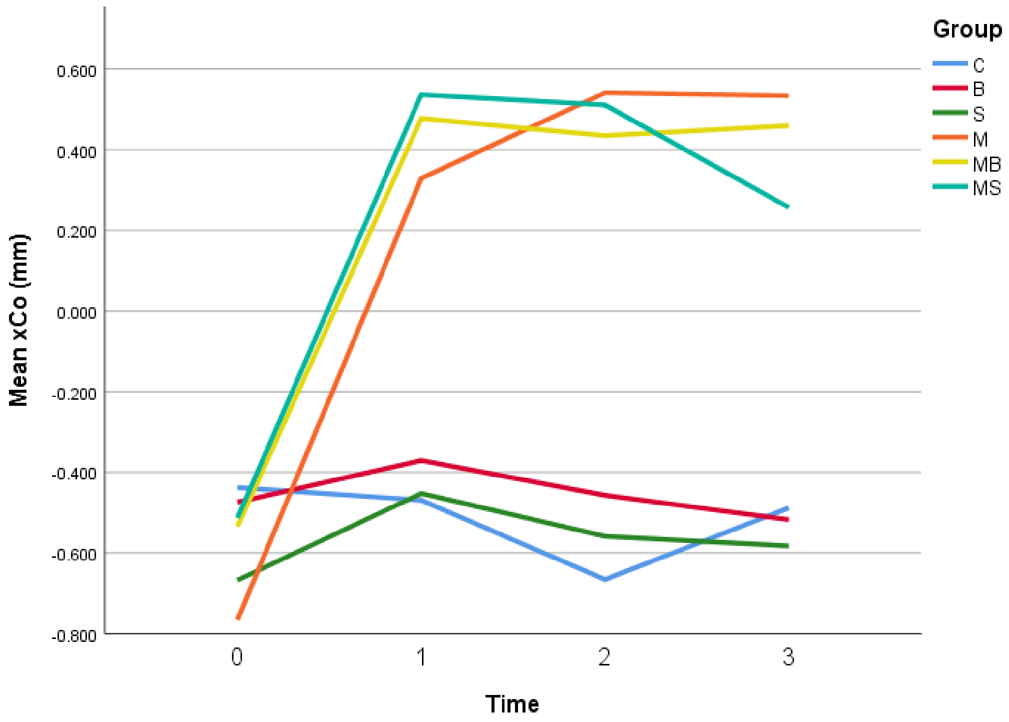


Figure 22: Line Graph of mean xCo (mm) for the LC-ST Groups at T0 to T3

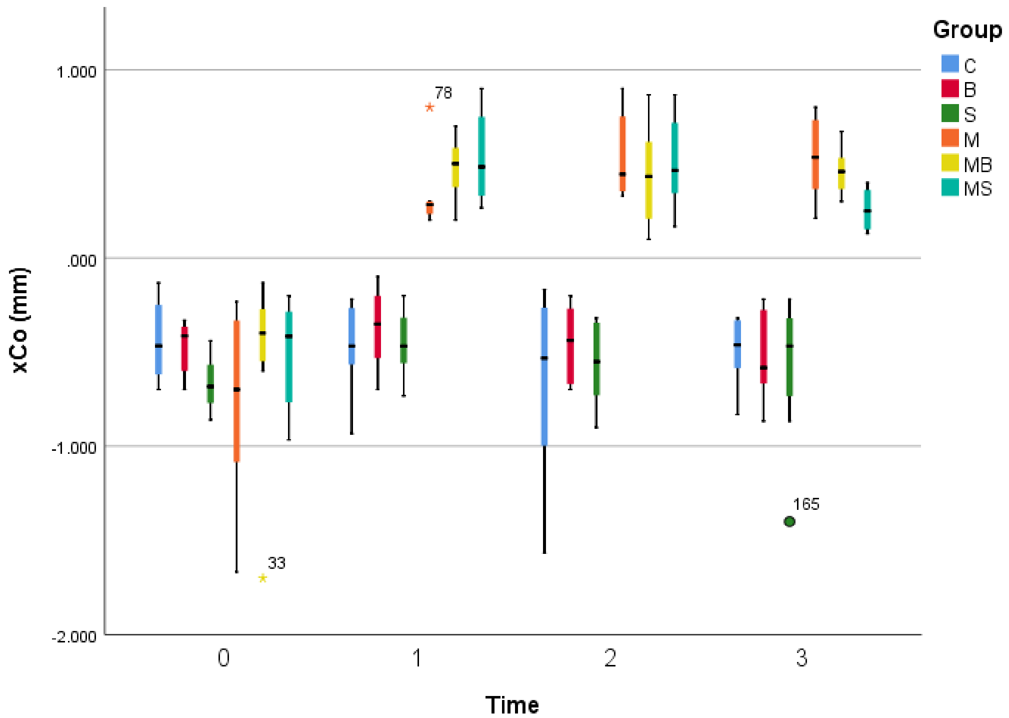


Figure 23: Boxplot of xCo (mm) for the LC-ST Groups at T0 to T3

5.2.1.5 LC-ST Horizontal Projection of Upper incisors (xUii)

Multiple comparisons within the groups between T0, T1, and T3 for xUii are displayed below (Table XVIII). A line graph of the group means and a boxplot of xUii data are displayed below in Figures 24 and 25. At T0 there were no significant differences in the horizontal projection of xUii between the groups. At T1 the M and MS group had significantly shorter xUii than the S group ($p \leq 0.01$). At T2 the M, MB, and MS group had significantly shorter xUii than the C, B, S groups ($p \leq 0.01$). At T3 the M an MS group had significantly shorter xUii than the C and S groups ($p \leq 0.01$).

Table XVIII: Multiple Comparisons Within Groups LC-ST for xUii

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-1.45	0.56	0.12	-3.62	0.72
		2	-1.89*	0.48	0.01	-3.86	0.08
		3	-2.53*	0.53	0.00	-4.65	-0.49
	1	2	-0.44	0.44	0.92	-2.23	1.35
		3	-1.12	0.50	0.23	-3.06	0.82
	2	3	-0.68	0.41	0.54	-2.31	0.94
B	0	1	-1.21*	0.44	0.10	-2.94	0.53
		2	-1.23	0.33	0.02	-2.54	0.09
		3	-1.73	0.62	0.11	-4.35	0.89
	1	2	-0.02	0.39	1.00	-1.66	1.62
		3	-0.53	0.66	0.97	-3.18	2.13
	2	3	-0.50	0.59	0.96	-3.14	2.14
S	0	1	-1.19	0.32	0.02	-2.45	0.07
		2	-1.66*	0.30	0.00	-2.84	-0.50
		3	-2.37*	0.47	0.00	-4.31	-0.44
	1	2	-0.48	0.30	0.59	-1.66	0.70
		3	-1.19	0.47	0.16	-3.12	0.75
	2	3	-0.71	0.45	0.62	-2.64	1.22
M	0	1	0.81	0.42	0.36	-0.81	2.43
		2	0.62	0.40	0.61	-0.93	2.17
		3	0.15	0.35	1.00	-1.22	1.52
	1	2	-0.20	0.42	1.00	-1.84	1.45
		3	-0.67	0.37	0.46	-2.16	0.83
	2	3	-0.47	0.35	0.75	-1.87	0.93
MB	0	1	-0.39	0.45	0.95	-2.13	1.36
		2	-0.49	0.37	0.77	-2.13	1.15
		3	-1.05	0.36	0.11	-2.70	0.60
	1	2	-0.10	0.31	1.00	-1.42	1.22
		3	-0.66	0.30	0.28	-1.99	0.66
	2	3	-0.56	0.16	0.02	-1.19	0.07
MS	0	1	0.59	0.47	0.80	-1.30	2.48
		2	0.08	0.44	1.00	-1.77	1.92
		3	-0.39	0.46	0.96	-2.26	1.49
	1	2	-0.51	0.33	0.62	-1.82	0.80
		3	-0.97*	0.36	0.10	-2.38	0.43
	2	3	-0.46	0.32	0.68	-1.72	0.79

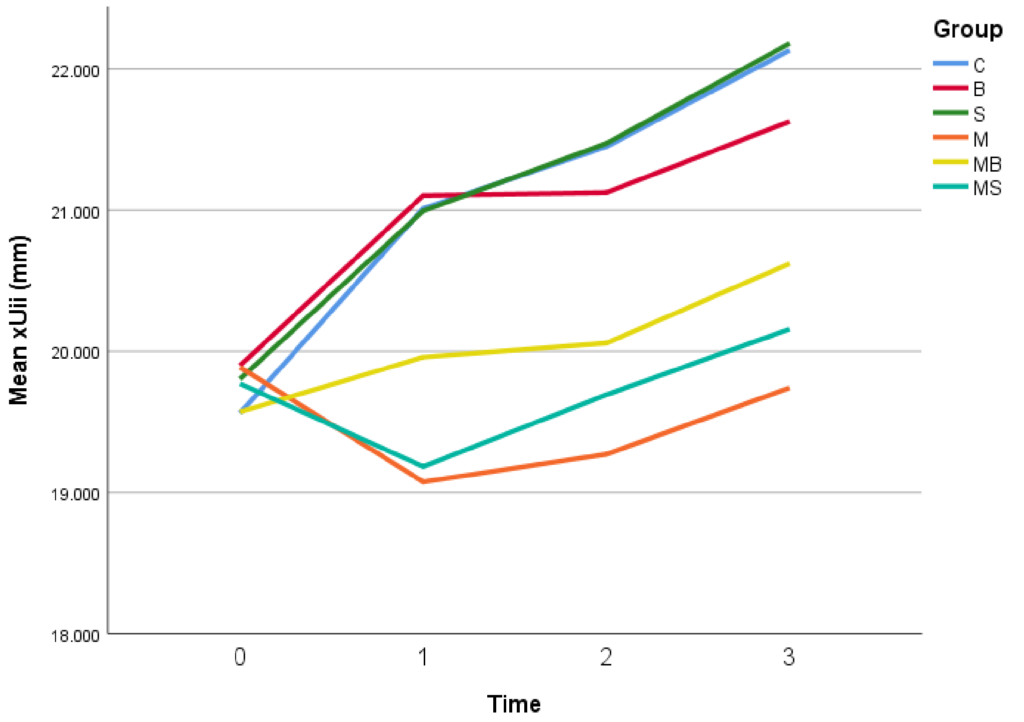


Figure 24: Line Graph of Mean xUii (mm) for LC-ST Groups from T0 to T3

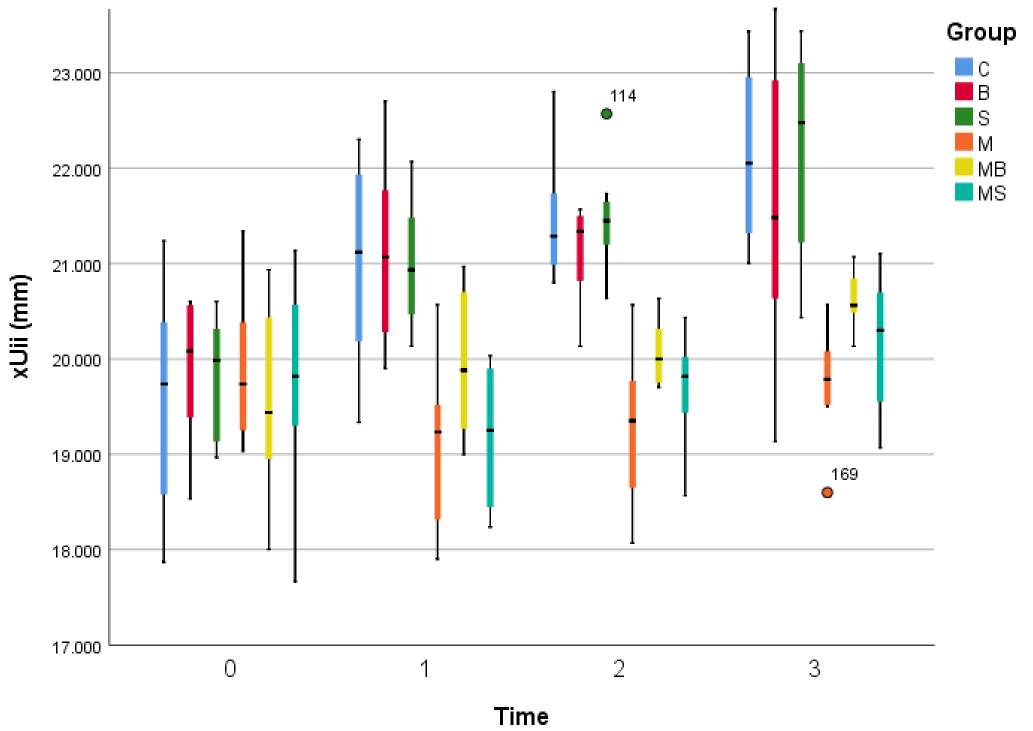


Figure 25: Boxplot of xUii (mm) for LC-ST Groups from T0 to T3

5.2.1.6 LC-ST Horizontal Projection of Lower incisors (xLis)

Multiple comparisons within the groups between T0, T1, and T3 for xLis are displayed below (Table XIX). A line graph of the group means and a boxplot of xLis are displayed below in Figures 26 and 27. At T0 and T1 there were no significant differences in the horizontal projection of xLis between the groups. At T2 the M group had a significantly shorter xLis than the S group ($p \leq 0.01$). The MS group had a significantly shorter xLis than the C, B, and S group ($p \leq 0.001$). At T3 the MS group had a significantly shorter xLis than the C and S group ($p \leq 0.01$).

Table XIX: Multiple Comparisons Within Groups LC-ST for xLis

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-1.21	0.54	0.23	-3.31	0.90
		2	-1.65	0.50	0.04	-3.63	0.34
		3	-2.06*	0.53	0.01	-4.12	-0.01
	1	2	-0.44	0.46	0.93	-2.25	1.37
		3	-0.85	0.49	0.48	-2.76	1.05
	2	3	-0.42	0.45	0.94	-2.15	1.32
B	0	1	-0.47	0.36	0.77	-1.95	1.01
		2	-0.36	0.38	0.93	-1.92	1.19
		3	-0.59	0.53	0.88	-2.93	1.76
	1	2	0.11	0.45	1.00	-1.65	1.87
		3	-0.12	0.59	1.00	-2.49	2.25
	2	3	-0.23	0.59	1.00	-2.61	2.16
S	0	1	-0.64	0.33	0.35	-1.93	0.64
		2	-1.06	0.45	0.19	-2.84	0.72
		3	-1.54	0.43	0.02	-3.24	0.16
	1	2	-0.42	0.42	0.92	-2.15	1.32
		3	-0.90	0.40	0.25	-2.53	0.74
	2	3	-0.48	0.50	0.93	-2.43	1.48
M	0	1	0.92	0.45	0.34	-0.93	2.76
		2	1.25	0.56	0.26	-1.13	3.63
		3	0.72	0.51	0.71	-1.40	2.83
	1	2	0.33	0.64	1.00	-2.17	2.84
		3	-0.20	0.59	1.00	-2.51	2.11
	2	3	-0.53	0.67	0.97	-3.16	2.09
MB	0	1	-0.06	0.41	1.00	-1.78	1.65
		2	0.02	0.66	1.00	-2.99	3.03
		3	-0.14	0.37	1.00	-1.63	1.34
	1	2	0.09	0.73	1.00	-2.91	3.08
		3	-0.08	0.48	1.00	-1.95	1.78
	2	3	-0.17	0.70	1.00	-3.14	2.80
MS	0	1	0.46	0.66	0.98	-2.17	3.09
		2	0.65	0.40	0.59	-1.08	2.38
		3	0.46	0.40	0.86	-1.27	2.18
	1	2	0.19	0.57	1.00	-2.41	2.80
		3	0.00	0.57	1.00	-2.61	2.60
	2	3	-0.19	0.23	0.96	-1.09	0.70

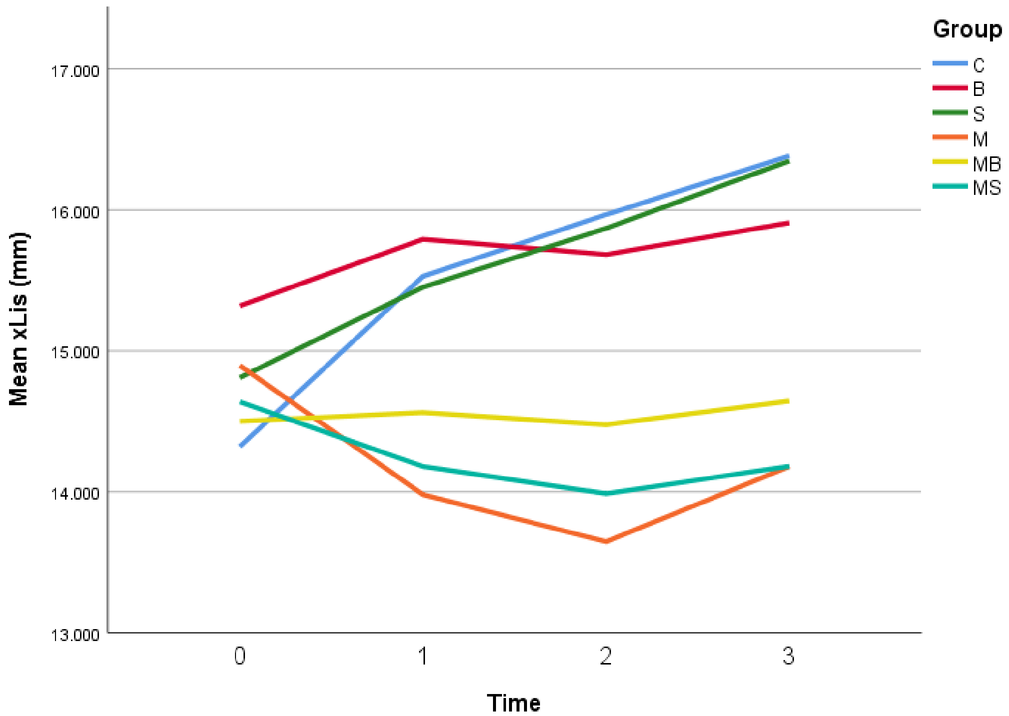


Figure 26: Line Graph of Mean xLii (mm) for LC-ST Groups from T0 to T3

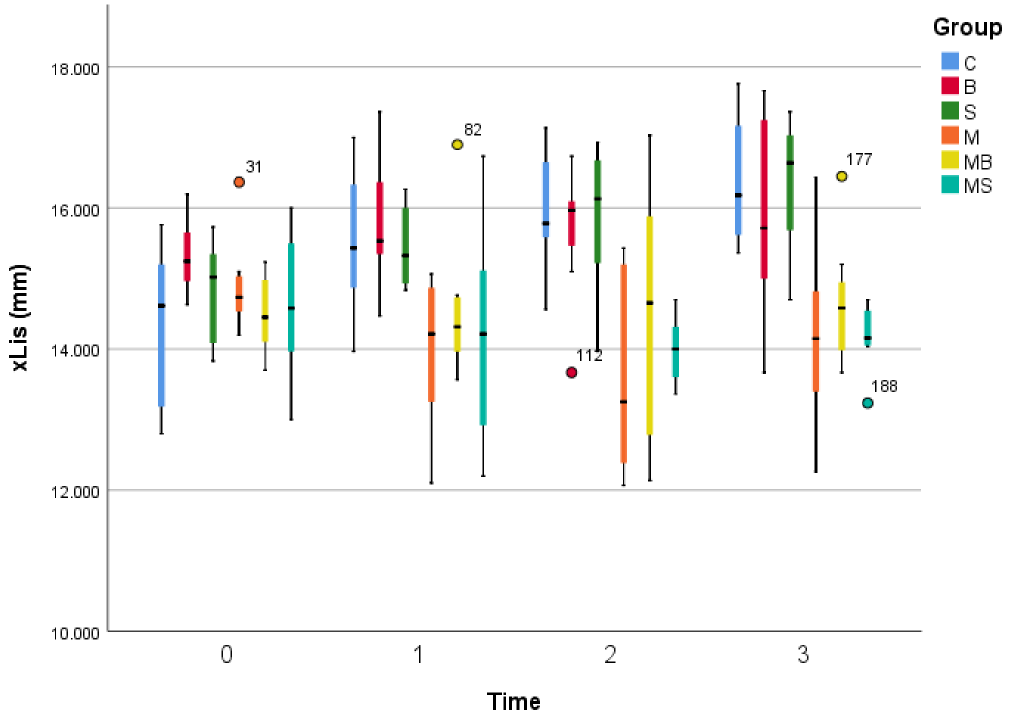


Figure 27: Boxplot of xLii (mm) for LC-ST Groups from T0 to T3

5.2.1.7 LC-ST Mandibular Plane Angle (MPA)

Multiple comparisons within the groups between T0, T1, and T3 for MPA are displayed below (Table XX). A line graph of the group means and a boxplot of MPA are displayed below in Figures 28 and 29. At T1 the M group had a significantly increased MPA than the C, B, and S groups ($p \leq 0.001$). The MB group had a significantly increased MPA than the C, B, S groups ($p \leq 0.001$) and the M group ($p \leq 0.01$). The MS group had a significantly increased MPA than the C, B, and S groups ($p \leq 0.001$). At T2 the M, MB, and MS groups had a significantly increased MPA than the C, B, and S groups ($p \leq 0.001$). At T3 the M group had a significantly increased MPA than the C and S groups ($p \leq 0.01$). The MB and MS groups had a significantly increased MPA than the C, B, and, S groups ($p \leq 0.001$). As expected all appliance groups showed an increased MPA.

Table XX: Multiple Comparisons Within Groups LC-ST for MPA

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	0.27	0.31	0.95	-0.92	1.46
		2	0.41	0.30	0.72	-0.75	1.57
		3	-0.13	0.33	1.00	-1.42	1.17
	1	2	0.14	0.30	1.00	-1.03	1.31
		3	-0.40	0.33	0.83	-1.70	0.91
	2	3	-0.54	0.33	0.55	-1.82	0.74
B	0	1	-0.12	0.37	1.00	-1.60	1.36
		2	-0.65	0.38	0.51	-2.14	0.85
		3	-0.76	0.38	0.35	-2.28	0.75
	1	2	-0.53	0.29	0.45	-1.66	0.61
		3	-0.64	0.30	0.27	-1.81	0.53
	2	3	-0.12	0.31	1.00	-1.33	1.10
S	0	1	0.04	0.33	1.00	-1.41	1.49
		2	0.32	0.33	0.93	-1.13	1.77
		3	0.38	0.38	0.91	-1.13	1.89
	1	2	0.28	0.16	0.50	-0.35	0.90
		3	0.34	0.25	0.76	-0.73	1.41
	2	3	0.06	0.25	1.00	-1.01	1.13
M	0	1	-4.78*	0.24	0.00	-5.71	-3.86
		2	-4.45*	0.42	0.00	-6.22	-2.68
		3	-3.48*	0.44	0.00	-5.40	-1.57
	1	2	0.34	0.41	0.97	-1.44	2.11
		3	1.30	0.44	0.09	-0.62	3.22
	2	3	0.97	0.55	0.48	-1.18	3.12
MB	0	1	-5.38*	0.23	0.00	-6.29	-4.49
		2	-4.31*	0.28	0.00	-5.43	-3.21
		3	-4.49*	0.36	0.00	-5.98	-3.01
	1	2	1.07*	0.27	0.01	-0.02	2.16
		3	0.89	0.35	0.16	-0.59	2.37
	2	3	-0.17	0.39	1.00	-1.71	1.36
MS	0	1	-4.48*	0.59	0.00	-6.88	-2.10
		2	-3.28*	0.41	0.00	-4.89	-1.68
		3	-3.68*	0.41	0.00	-5.27	-2.10
	1	2	1.20	0.58	0.31	-1.17	3.58
		3	0.80	0.57	0.71	-1.57	3.18
	2	3	-0.40	0.39	0.91	-1.91	1.12

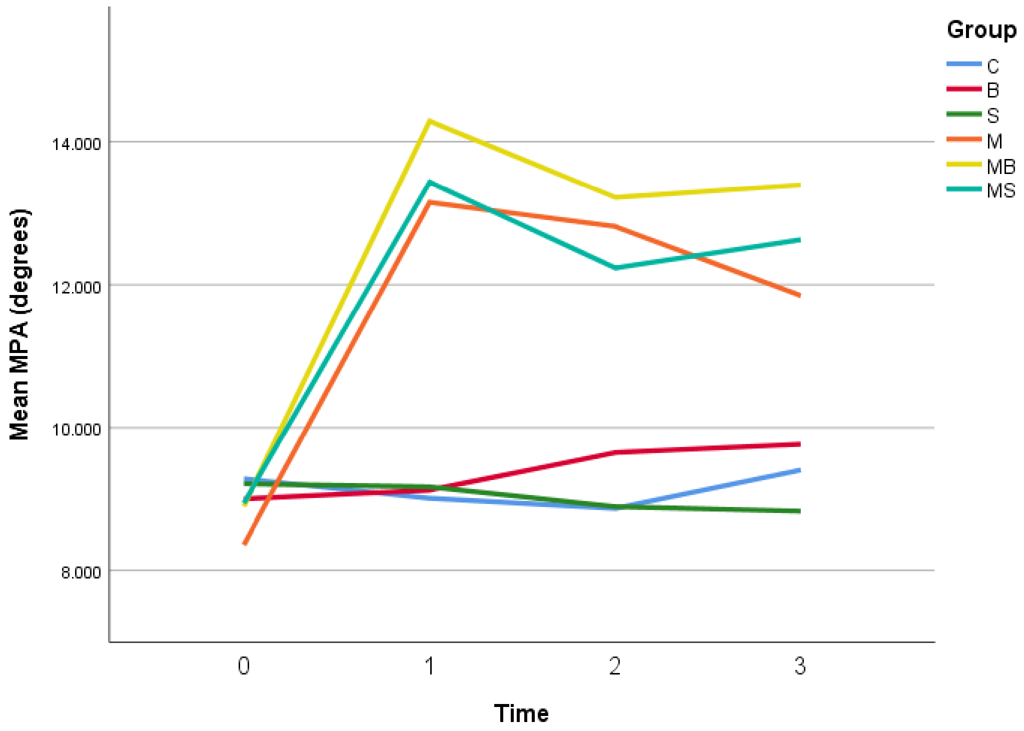


Figure 28: Line Graph of mean MPA (º) for LC-ST Groups from T0 to T3

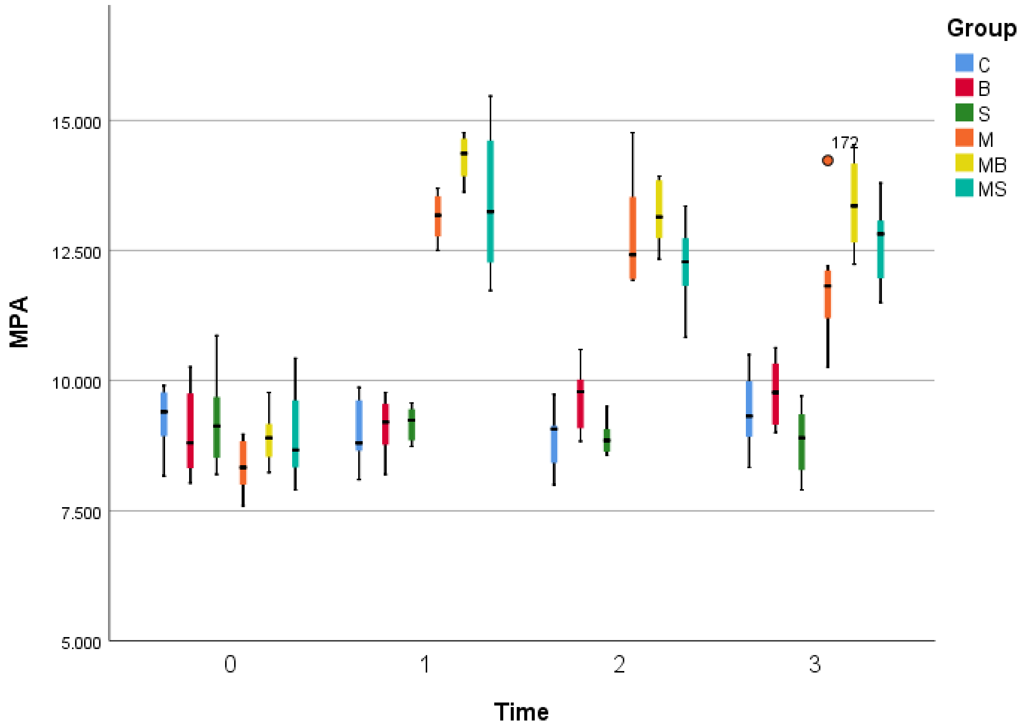


Figure 29: Boxplot of MPA (º) for LC-ST Groups from T0 to T3

5.2.1.8 LC-ST Angle of Opening (AoO)

Multiple comparisons within the groups between T0, T1, and T3 for AoO are displayed below (Table XXI). A line graph of the group means and a boxplot of AoO are displayed below in Figures 30 and 31. At T1 the M, MB, and MS groups had a significantly increased AoO than the C, B, and S groups ($p \leq 0.001$). This finding was replicated at T2 and T3 ($p \leq 0.01$). As expected all appliance groups had an increased angle of opening during appliance wear.

Table XXI: Multiple Comparisons Within Groups LC-ST AoO

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-0.35	0.31	0.86	-1.61	0.91
		2	-0.06	0.50	1.00	-2.07	1.95
		3	-0.16	0.37	1.00	-1.58	1.27
	1	2	0.29	0.45	0.99	-1.70	2.27
		3	0.19	0.30	0.99	-1.03	1.41
	2	3	-0.10	0.49	1.00	-2.10	1.90
B	0	1	0.14	0.41	1.00	-1.79	2.08
		2	-0.52	0.42	0.83	-2.50	1.46
		3	-0.13	0.17	0.98	-0.80	0.55
	1	2	-0.66	0.58	0.85	-2.89	1.57
		3	-0.27	0.42	0.99	-2.18	1.64
	2	3	0.39	0.43	0.95	-1.57	2.35
S	0	1	0.35	0.20	0.50	-0.50	1.20
		2	0.03	0.19	1.00	-0.78	0.83
		3	0.12	0.15	0.97	-0.49	0.74
	1	2	-0.32	0.25	0.77	-1.29	0.64
		3	-0.23	0.22	0.91	-1.11	0.66
	2	3	0.10	0.21	1.00	-0.75	0.94
M	0	1	-4.85*	0.60	0.00	-7.36	-2.35
		2	-3.65*	0.54	0.00	-5.84	-1.46
		3	-2.00*	0.44	0.00	-3.71	-0.31
	1	2	1.21	0.70	0.50	-1.53	3.94
		3	2.85*	0.63	0.00	0.31	5.39
	2	3	1.64	0.57	0.08	-0.62	3.90
MB	0	1	-5.84*	0.46	0.00	-7.93	-3.76
		2	-5.07*	0.28	0.00	-6.26	-3.90
		3	-4.58*	0.52	0.00	-6.99	-2.18
	1	2	0.77	0.50	0.64	-1.30	2.83
		3	1.26	0.66	0.39	-1.32	3.85
	2	3	0.50	0.56	0.95	-1.87	2.86
MS	0	1	-5.51*	0.47	0.00	-7.39	-3.65
		2	-3.33*	0.45	0.00	-5.15	-1.53
		3	-3.36*	0.33	0.00	-4.67	-2.07
	1	2	2.17*	0.54	0.01	0.10	4.26
		3	2.15*	0.44	0.00	0.32	3.98
	2	3	-0.03	0.42	1.00	-1.78	1.72

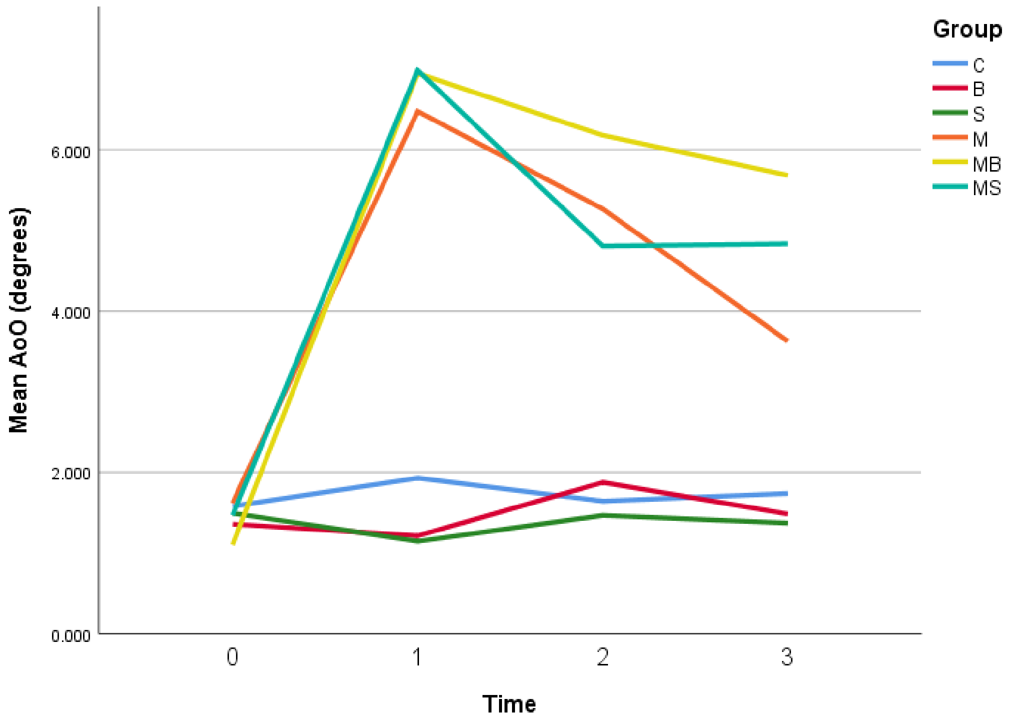


Figure 30: Line Graph of mean AoO (º) for LC-ST Groups from T0 to T3

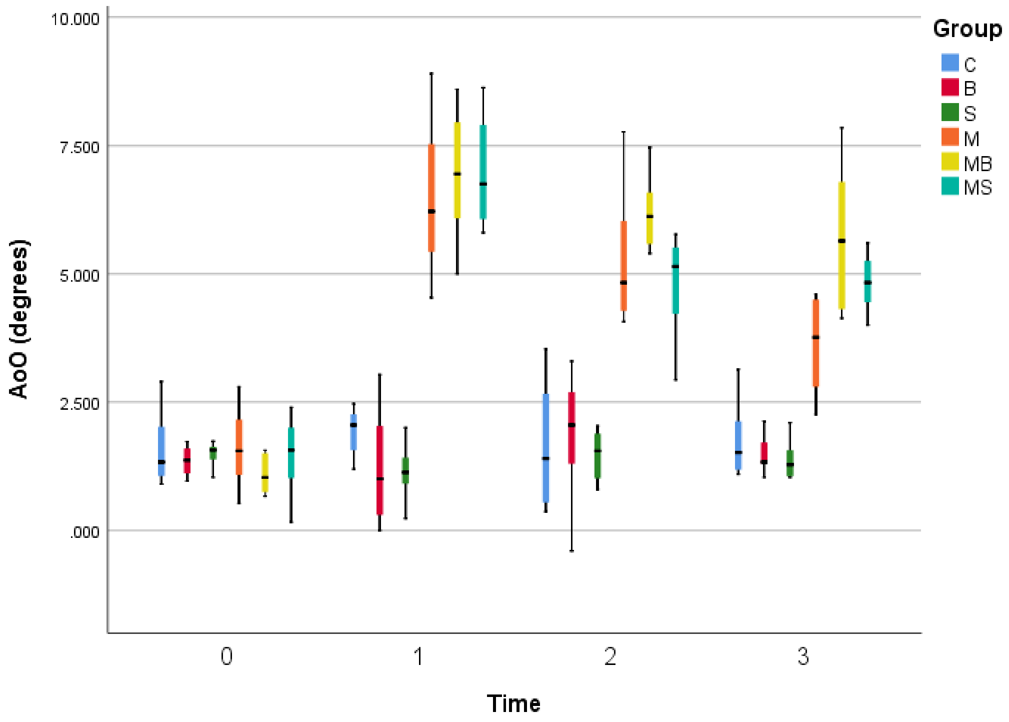


Figure 31: Boxplot of AoO (º) for LC-ST Groups from T0 to T3

5.2.2 Long-term Groups Lateral Cephalometric Results

The means and standard deviations (SD) for the Long-Term (LT) Lateral Cephalometric (LC) groups are displayed below in Table XIII. Boxplots for those variables without significant or interesting findings can be referred to in Appendix 4.

Table XXII: Means and Standard Deviations for the LC-LT Groups

Variable	Time	CL	BL	BLR	SL	SLR	ML	MBL	MBLR	MSL	MSLR
		Group									
		Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001									
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
OSL (mm)	T0	33.18 ± 0.44	32.51 ± 2.01	32.53 ± 0.81	31.94 ± 1.58	31.57 ± 1.27	33.18 ± 1.01	34.21 ± 0.84	33.99 ± 1.07	34.47 ± 1.07	33.87 ± 0.96
	T1	34.80 ± 0.18	34.42 ± 1.66	34.28 ± 0.76	33.95 ± 1.60	34.35 ± 1.37	33.72 ± 1.00	34.21 ± 0.84	34.21 ± 1.01	34.68 ± 1.05	34.30 ± 0.49
	T2	36.38 ± 0.27	35.45 ± 1.48	35.77 ± 0.81	35.47 ± 0.96	35.69 ± 0.80	34.79 ± 0.90	35.43 ± 0.80	35.92 ± 0.77	35.40 ± 0.96	35.17 ± 0.54
	T3	37.27 ± 0.36	36.22 ± 0.93	35.77 ± 0.81	36.18 ± 0.84	36.42 ± 0.96	34.92 ± 0.62	35.96 ± 0.76	36.01 ± 0.95	36.88 ± 1.12	35.31 ± 1.15
	T4	38.17 ± 0.53	37.29 ± 1.46	36.41 ± 1.27	37.28 ± 1.05	37.45 ± 1.41	36.39 ± 1.02	37.60 ± 0.76	36.33 ± 1.85	37.29 ± 1.10	36.38 ± 1.06
	T5	39.47 ± 0.79	38.25 ± 1.72	37.84 ± 1.27	38.38 ± 0.69	38.67 ± 0.96	37.72 ± 1.09	38.80 ± 0.73	37.94 ± 0.45	39.23 ± 1.12	38.20 ± 1.20
	T6	41.66 ± 0.93	40.27 ± 1.83	39.78 ± 1.09	39.64 ± 0.37	39.68 ± 0.85	39.77 ± 1.12	41.09 ± 0.86	40.01 ± 0.91	41.50 ± 0.38	40.35 ± 1.29
	T7	43.38 ± 1.11	41.84 ± 1.61	41.23 ± 1.24	41.91 ± 0.91	42.39 ± 0.69	41.57 ± 1.08	41.74 ± 0.50	41.74 ± 0.77	42.52 ± 0.48	41.08 ± 1.26
BSL (mm)	T0	4.60 ± 0.47	4.79 ± 0.15	5.16 ± 0.16	4.74 ± 0.29	4.75 ± 0.20	4.79 ± 0.73	5.23 ± 0.37	5.16 ± 0.19	5.18 ± 0.30	4.80 ± 0.41
	T1	5.23 ± 0.52	5.36 ± 0.33	5.57 ± 0.27	5.28 ± 0.14	5.47 ± 0.29	5.13 ± 0.53	5.23 ± 0.37	5.68 ± 0.21	5.50 ± 0.41	5.46 ± 0.31
	T2	5.88 ± 0.74	5.65 ± 0.36	6.00 ± 0.26	5.83 ± 0.27	5.97 ± 0.28	5.59 ± 0.23	5.62 ± 0.31	6.04 ± 0.15	6.04 ± 0.43	5.77 ± 0.26
	T3	6.15 ± 0.34	6.06 ± 0.56	6.00 ± 0.26	6.06 ± 0.21	6.23 ± 0.34	6.08 ± 0.22	6.12 ± 0.26	6.35 ± 0.21	6.21 ± 0.35	6.14 ± 0.44
	T4	6.67 ± 0.19	6.72 ± 0.41	6.59 ± 0.38	6.37 ± 0.34	6.51 ± 0.39	6.46 ± 0.32	6.39 ± 0.37	6.67 ± 0.22	6.71 ± 0.50	6.42 ± 0.27
	T5	7.29 ± 0.51	7.15 ± 0.30	6.82 ± 0.40	6.94 ± 0.25	6.92 ± 0.20	6.80 ± 0.25	6.80 ± 0.37	7.09 ± 0.29	7.22 ± 0.33	6.87 ± 0.20
	T6	7.74 ± 0.69	7.60 ± 0.34	7.51 ± 0.27	7.34 ± 0.30	7.20 ± 0.32	7.36 ± 0.23	7.39 ± 0.29	7.61 ± 0.23	7.74 ± 0.31	7.40 ± 0.25
	T7	8.04 ± 0.23	8.09 ± 0.22	8.06 ± 0.58	7.83 ± 0.27	7.93 ± 0.35	7.96 ± 0.29	8.04 ± 0.30	8.40 ± 0.37	7.92 ± 0.20	7.67 ± 0.43
S↔Uii (mm)	T0	19.68 ± 0.35	18.95 ± 1.43	18.79 ± 0.46	18.64 ± 0.87	18.65 ± 0.70	19.61 ± 0.39	19.90 ± 0.38	20.13 ± 0.94	20.19 ± 0.78	20.38 ± 0.80
	T1	20.80 ± 0.38	20.33 ± 1.04	19.91 ± 0.37	20.13 ± 1.11	20.34 ± 1.08	19.55 ± 0.75	19.90 ± 0.38	19.85 ± 1.72	19.91 ± 0.95	20.00 ± 0.68
	T2	21.80 ± 0.54	21.06 ± 0.86	21.21 ± 0.53	21.00 ± 0.49	21.39 ± 0.50	20.00 ± 0.88	20.58 ± 0.49	20.35 ± 0.60	20.73 ± 0.85	20.33 ± 0.57
	T3	22.22 ± 0.71	21.07 ± 0.78	21.21 ± 0.53	21.36 ± 0.48	21.57 ± 0.59	19.86 ± 0.65	20.74 ± 0.81	20.69 ± 0.31	19.70 ± 0.57	19.33 ± 0.38
	T4	22.83 ± 0.66	22.06 ± 1.12	21.11 ± 0.76	22.27 ± 0.75	22.49 ± 0.03	20.75 ± 0.80	22.06 ± 0.89	21.64 ± 0.76	21.79 ± 1.37	21.12 ± 1.04
	T5	24.10 ± 0.44	22.26 ± 1.60	21.98 ± 0.80	22.83 ± 0.56	23.33 ± 0.23	22.02 ± 0.95	23.39 ± 0.73	21.98 ± 0.80	23.05 ± 0.93	22.38 ± 1.17
	T6	25.22 ± 0.94	24.00 ± 1.56	23.32 ± 1.03	23.46 ± 0.47	24.15 ± 0.36	23.71 ± 1.30	24.56 ± 0.68	22.97 ± 0.18	24.56 ± 0.50	23.86 ± 1.17

	T7	26.01 ± 0.89	25.08 ± 1.04	23.77 ± 0.81	25.05 ± 0.77	25.55 ± 0.55	24.93 ± 1.23	24.79 ± 0.47	24.47 ± 0.20	24.65 ± 0.98	24.39 ± 1.41
	T0	7.09 ± 0.54	6.47 ± 0.87	6.73 ± 0.22	6.29 ± 0.54	6.37 ± 0.39	7.13 ± 0.65	6.70 ± 0.51	6.97 ± 0.49	7.06 ± 0.80	6.84 ± 0.70
	T1	7.28 ± 0.62	7.17 ± 0.30	6.89 ± 0.31	7.27 ± 0.70	7.28 ± 0.42	7.24 ± 0.85	6.70 ± 0.51	6.78 ± 0.57	7.07 ± 0.77	7.18 ± 0.96
	T2	7.85 ± 0.56	7.16 ± 0.62	7.70 ± 0.54	7.98 ± 0.64	7.88 ± 0.61	7.30 ± 0.38	7.55 ± 0.40	6.84 ± 0.50	7.64 ± 0.77	7.37 ± 0.73
Go↔Ag	T3	8.74 ± 0.42	7.25 ± 1.13	7.45 ± 0.87	8.02 ± 0.46	8.42 ± 0.40	7.21 ± 0.74	7.45 ± 0.71	6.96 ± 0.84	7.58 ± 0.88	7.52 ± 0.61
(mm)	T4	9.15 ± 0.28	7.81 ± 1.14	7.68 ± 0.57	9.18 ± 0.61	9.00 ± 0.62	8.28 ± 0.41	8.64 ± 0.28	7.15 ± 0.85	7.99 ± 0.81	8.57 ± 0.66
	T5	9.98 ± 1.11	8.02 ± 1.44	7.44 ± 0.50	9.59 ± 0.61	9.67 ± 0.89	8.76 ± 0.70	8.80 ± 0.28	7.45 ± 0.64	9.12 ± 0.87	8.71 ± 0.60
	T6	10.65 ± 0.53	8.82 ± 1.11	8.00 ± 0.44	9.58 ± 0.61	10.15 ± 0.03	9.41 ± 0.98	9.93 ± 0.96	8.49 ± 0.62	10.13 ± 1.01	9.82 ± 0.95
	T7	11.38 ± 0.93	9.48 ± 1.21	8.50 ± 0.53	11.38 ± 0.46	11.37 ± 0.79	9.93 ± 0.80	10.08 ± 0.70	9.16 ± 0.31	10.66 ± 0.87	10.40 ± 0.75
	T0	16.67 ± 0.65	16.14 ± 1.43	16.28 ± 0.32	16.07 ± 1.13	15.94 ± 1.96	17.26 ± 0.83	16.98 ± 0.54	17.33 ± 1.79	17.45 ± 0.72	17.15 ± 0.66
	T1	17.54 ± 0.64	17.45 ± 0.74	17.06 ± 0.69	17.76 ± 1.02	18.00 ± 1.12	17.91 ± 0.63	16.98 ± 0.54	17.80 ± 1.52	18.25 ± 0.84	18.47 ± 0.85
	T2	18.66 ± 0.35	18.11 ± 0.61	17.45 ± 0.74	18.85 ± 0.90	19.04 ± 0.64	18.10 ± 0.57	18.47 ± 0.54	17.75 ± 0.66	18.88 ± 1.13	18.15 ± 1.16
Go↔Lii	T3	19.05 ± 0.46	18.33 ± 0.59	17.95 ± 0.59	19.25 ± 0.66	19.20 ± 0.49	18.11 ± 0.74	17.60 ± 1.34	16.92 ± 0.18	18.78 ± 1.16	18.57 ± 0.98
(mm)	T4	20.15 ± 0.68	18.89 ± 1.01	17.34 ± 0.80	20.34 ± 0.82	20.44 ± 0.08	19.55 ± 0.54	18.94 ± 0.30	18.24 ± 0.82	18.79 ± 0.91	19.17 ± 0.71
	T5	21.30 ± 0.86	19.30 ± 1.42	18.35 ± 0.99	20.70 ± 0.45	21.20 ± 0.99	19.44 ± 0.88	19.55 ± 0.48	18.82 ± 0.61	20.21 ± 0.93	19.80 ± 0.87
	T6	21.60 ± 0.50	20.56 ± 1.31	20.09 ± 0.76	21.70 ± 0.66	21.51 ± 0.30	20.51 ± 0.90	21.32 ± 0.62	20.80 ± 0.11	21.71 ± 0.74	21.02 ± 1.08
	T7	22.99 ± 0.55	21.83 ± 1.05	21.76 ± 0.58	23.14 ± 0.77	22.88 ± 0.56	21.79 ± 0.45	22.16 ± 0.87	21.85 ± 0.82	22.56 ± 0.74	21.90 ± 0.43
	T0	15.11 ± 0.29	14.79 ± 0.56	15.04 ± 0.45	14.41 ± 0.82	14.50 ± 0.96	15.58 ± 0.43	16.24 ± 0.66	15.99 ± 0.55	15.64 ± 0.76	15.69 ± 0.68
	T1	16.21 ± 0.40	15.63 ± 0.89	15.81 ± 0.60	16.12 ± 1.01	15.90 ± 1.86	16.50 ± 0.96	16.74 ± 0.34	17.15 ± 1.66	16.67 ± 1.01	17.03 ± 0.47
	T2	17.02 ± 0.33	16.17 ± 0.84	16.39 ± 0.78	17.04 ± 0.77	17.16 ± 0.68	16.54 ± 0.59	17.81 ± 0.62	17.32 ± 0.39	16.65 ± 0.93	16.57 ± 1.06
Co↔Dg	T3	17.36 ± 0.68	17.31 ± 0.43	16.76 ± 0.53	17.40 ± 0.50	17.58 ± 0.38	17.38 ± 0.55	18.05 ± 0.54	18.30 ± 0.40	17.82 ± 0.38	17.39 ± 0.39
(mm)	T4	18.10 ± 0.64	17.14 ± 0.89	16.92 ± 0.71	17.96 ± 0.73	17.84 ± 0.56	17.43 ± 0.61	18.40 ± 0.50	18.32 ± 0.66	17.74 ± 0.82	17.54 ± 0.81
	T5	18.98 ± 0.99	18.05 ± 1.24	17.64 ± 0.82	18.79 ± 0.55	18.80 ± 0.55	18.40 ± 0.34	18.81 ± 0.80	19.11 ± 0.67	19.17 ± 0.55	18.56 ± 0.66
	T6	19.67 ± 0.72	19.09 ± 1.05	18.99 ± 0.80	19.73 ± 0.46	19.45 ± 0.51	19.10 ± 0.48	20.39 ± 0.47	20.26 ± 0.34	19.46 ± 0.57	19.51 ± 0.96
	T7	20.25 ± 0.56	19.61 ± 0.59	19.92 ± 0.59	18.94 ± 0.73	19.63 ± 0.59	20.03 ± 0.31	20.79 ± 0.34	20.85 ± 0.56	20.02 ± 0.60	20.00 ± 0.42
	T0	12.75 ± 0.48	12.32 ± 0.90	12.36 ± 0.41	12.20 ± 0.68	12.39 ± 0.09	12.87 ± 0.76	13.43 ± 0.70	13.10 ± 0.59	13.21 ± 0.71	12.80 ± 0.69
	T1	13.35 ± 0.64	13.16 ± 0.60	13.06 ± 0.38	13.26 ± 0.71	13.29 ± 0.56	13.88 ± 0.83	13.80 ± 0.16	14.08 ± 0.36	14.15 ± 0.80	14.12 ± 0.82
	T2	14.17 ± 0.60	13.69 ± 0.65	13.66 ± 0.41	14.29 ± 0.87	14.37 ± 0.80	14.93 ± 1.09	15.26 ± 1.00	14.79 ± 0.83	14.34 ± 0.52	14.29 ± 0.75
Ar↔Dg	T3	14.99 ± 0.47	14.16 ± 0.68	13.66 ± 0.41	14.82 ± 0.26	14.88 ± 0.40	15.19 ± 0.81	15.24 ± 0.48	15.61 ± 0.65	14.94 ± 0.70	14.56 ± 0.56
(mm)	T4	15.08 ± 0.60	14.58 ± 0.81	13.98 ± 0.61	15.24 ± 0.64	15.31 ± 0.61	15.30 ± 0.25	16.12 ± 0.35	16.06 ± 0.78	15.75 ± 0.42	15.40 ± 0.48
	T5	15.94 ± 0.70	15.26 ± 0.85	14.87 ± 0.65	15.82 ± 0.49	15.91 ± 0.55	15.57 ± 0.46	16.45 ± 0.47	16.22 ± 0.55	15.86 ± 0.72	15.45 ± 0.67
	T6	16.39 ± 0.28	15.94 ± 0.84	15.79 ± 0.66	16.85 ± 0.40	16.57 ± 0.26	16.18 ± 0.59	17.31 ± 0.73	17.25 ± 0.64	16.65 ± 0.46	16.33 ± 0.85
	T7	17.66 ± 0.48	17.19 ± 0.82	16.64 ± 0.56	17.58 ± 0.60	17.84 ± 0.64	17.39 ± 0.37	18.06 ± 0.45	18.29 ± 0.49	17.69 ± 0.63	17.07 ± 0.75
xCo	T0	-0.41 ± 0.13	-0.42 ± 0.14	-0.42 ± 0.20	-0.44 ± 0.17	-0.45 ± 0.24	-0.47 ± 0.12	-0.24 ± 0.10	-0.39 ± 0.20	-0.52 ± 0.28	-0.56 ± 0.28

(mm)	T1	-0.36 ± 0.19	-0.31 ± 0.18	-0.64 ± 0.22	-0.66 ± 0.30	-0.57 ± 0.25	0.53 ± 0.21	0.46 ± 0.12	0.26 ± 0.11	0.54 ± 0.23	0.44 ± 0.27
	T2	-0.44 ± 0.21	-0.47 ± 0.15	-0.67 ± 0.15	-0.52 ± 0.28	-0.41 ± 0.19	0.51 ± 0.24	0.42 ± 0.27	0.42 ± 0.20	0.47 ± 0.20	0.49 ± 0.18
	T3	-0.51 ± 0.30	-0.47 ± 0.23	-0.46 ± 0.15	-0.41 ± 0.13	-0.44 ± 0.14	0.33 ± 0.19	0.48 ± 0.17	0.54 ± 0.25	0.43 ± 0.14	0.46 ± 0.18
	T4	-0.57 ± 0.22	-0.65 ± 0.15	-0.40 ± 0.21	-0.48 ± 0.19	-0.43 ± 0.16	0.37 ± 0.14	0.35 ± 0.16	0.37 ± 0.18	0.34 ± 0.08	0.33 ± 0.09
	T5	-0.38 ± 0.12	-0.42 ± 0.26	-0.46 ± 0.20	-0.56 ± 0.23	-0.47 ± 0.23	-0.16 ± 0.32	0.33 ± 0.09	0.33 ± 0.06	-0.01 ± 0.12	-0.02 ± 0.15
	T6	-0.60 ± 0.19	-0.46 ± 0.20	-0.43 ± 0.14	-0.54 ± 0.25	-0.39 ± 0.14	-0.25 ± 0.25	0.28 ± 0.06	0.32 ± 0.06	-0.31 ± 0.21	-0.37 ± 0.11
	T7	-0.49 ± 0.18	-0.52 ± 0.24	-0.46 ± 0.21	-0.49 ± 0.25	-0.44 ± 0.13	-0.28 ± 0.07	0.26 ± 0.07	0.32 ± 0.06	-0.32 ± 0.15	-0.33 ± 0.13
Co↔Mn (mm)	T0	7.83 ± 0.51	7.29 ± 0.64	7.57 ± 0.84	7.64 ± 0.97	7.24 ± 0.81	7.98 ± 0.36	8.02 ± 0.41	7.68 ± 0.35	8.09 ± 0.45	8.04 ± 0.51
	T1	8.19 ± 0.48	7.28 ± 0.62	7.72 ± 0.37	7.93 ± 0.50	7.95 ± 0.84	7.87 ± 0.59	8.02 ± 0.41	7.73 ± 0.81	8.11 ± 0.64	8.08 ± 0.39
	T2	8.48 ± 0.38	8.09 ± 0.51	7.97 ± 0.48	8.66 ± 0.25	8.61 ± 0.64	8.07 ± 0.50	7.95 ± 0.46	7.78 ± 0.74	8.41 ± 0.65	8.30 ± 0.68
	T3	8.90 ± 0.54	8.16 ± 0.33	7.72 ± 0.31	8.43 ± 0.45	8.65 ± 0.44	7.84 ± 0.65	8.16 ± 0.58	7.98 ± 0.52	8.58 ± 0.83	8.70 ± 0.83
	T4	9.40 ± 0.44	8.42 ± 0.69	7.41 ± 0.66	9.18 ± 0.65	9.25 ± 0.79	8.78 ± 0.63	8.57 ± 0.55	7.64 ± 0.32	9.04 ± 0.95	9.45 ± 1.03
	T5	9.98 ± 0.37	8.71 ± 0.66	8.41 ± 0.29	9.51 ± 0.27	9.74 ± 0.74	9.10 ± 0.68	9.13 ± 0.54	8.26 ± 0.49	9.81 ± 0.41	9.80 ± 0.44
	T6	10.52 ± 0.96	9.12 ± 0.72	8.77 ± 0.42	10.14 ± 1.08	10.10 ± 1.74	9.77 ± 0.41	10.03 ± 0.31	9.15 ± 1.57	10.74 ± 0.55	10.24 ± 0.96
	T7	10.92 ± 0.53	9.84 ± 1.01	9.74 ± 0.48	10.85 ± 0.65	10.96 ± 0.38	10.42 ± 0.29	10.11 ± 0.39	10.08 ± 0.55	10.80 ± 0.80	10.87 ± 0.97
yCo (mm)	T0	2.48 ± 0.26	2.63 ± 0.25	2.62 ± 0.19	2.58 ± 0.29	2.55 ± 0.29	2.41 ± 0.32	2.75 ± 0.54	2.29 ± 0.25	2.67 ± 0.50	2.69 ± 0.42
	T1	2.70 ± 0.40	2.52 ± 0.36	2.57 ± 0.29	2.34 ± 0.25	2.13 ± 0.39	2.45 ± 0.35	2.87 ± 0.42	2.72 ± 0.27	2.56 ± 0.19	2.53 ± 0.30
	T2	2.33 ± 0.28	2.48 ± 0.27	2.41 ± 0.31	2.32 ± 0.23	2.56 ± 0.33	2.36 ± 0.27	2.35 ± 0.34	2.47 ± 0.24	2.79 ± 0.21	2.63 ± 0.37
	T3	2.32 ± 0.37	2.30 ± 0.23	2.40 ± 0.30	2.48 ± 0.37	2.45 ± 0.35	2.30 ± 0.22	2.53 ± 0.35	2.51 ± 0.27	2.50 ± 0.36	2.76 ± 0.24
	T4	2.65 ± 0.29	2.47 ± 0.35	2.44 ± 0.32	2.31 ± 0.33	2.60 ± 0.25	2.47 ± 0.33	2.33 ± 0.26	2.49 ± 0.22	2.74 ± 0.25	2.73 ± 0.68
	T5	2.43 ± 0.37	2.49 ± 0.30	2.28 ± 0.29	2.50 ± 0.32	2.62 ± 0.43	2.45 ± 0.45	2.28 ± 0.11	2.60 ± 0.29	2.72 ± 0.38	2.95 ± 0.38
	T6	2.66 ± 0.49	2.50 ± 0.39	2.48 ± 0.21	2.51 ± 0.35	2.40 ± 0.23	2.42 ± 0.28	2.31 ± 0.14	2.56 ± 0.28	2.93 ± 0.41	3.00 ± 0.56
	T7	2.78 ± 0.12	2.44 ± 0.27	2.48 ± 0.25	2.32 ± 0.39	2.60 ± 0.22	2.57 ± 0.17	2.66 ± 0.33	2.44 ± 0.28	2.77 ± 0.25	2.87 ± 0.56
xUii (mm)	T0	19.21 ± 0.35	19.25 ± 0.55	18.74 ± 0.68	18.46 ± 0.98	18.28 ± 0.90	19.12 ± 0.32	19.52 ± 0.34	19.21 ± 0.70	19.16 ± 0.82	19.10 ± 0.54
	T1	20.07 ± 0.71	19.76 ± 0.95	19.63 ± 0.64	19.63 ± 1.02	19.77 ± 1.06	18.56 ± 0.72	19.52 ± 0.34	19.45 ± 1.31	18.62 ± 0.86	18.90 ± 0.95
	T2	20.84 ± 0.47	20.49 ± 0.84	20.56 ± 0.60	20.51 ± 0.43	20.75 ± 0.55	18.92 ± 0.59	19.86 ± 0.49	19.88 ± 0.47	19.12 ± 0.59	18.93 ± 0.70
	T3	21.04 ± 0.72	20.85 ± 0.72	20.56 ± 0.60	20.67 ± 0.64	20.92 ± 0.53	19.26 ± 0.65	19.83 ± 0.66	20.16 ± 0.53	19.53 ± 0.87	19.09 ± 0.36
	T4	21.68 ± 1.21	21.33 ± 1.10	20.96 ± 0.70	21.57 ± 0.76	21.48 ± 0.40	20.20 ± 0.80	21.52 ± 0.86	20.61 ± 0.57	20.94 ± 1.34	20.55 ± 0.69
	T5	21.53 ± 0.96	21.51 ± 1.50	21.32 ± 0.76	21.93 ± 0.69	22.20 ± 0.58	21.53 ± 0.93	22.07 ± 0.99	21.42 ± 0.92	22.13 ± 0.83	21.57 ± 1.19
	T6	23.58 ± 0.64	23.09 ± 1.55	22.64 ± 0.97	22.50 ± 0.56	22.87 ± 0.39	23.14 ± 1.33	23.62 ± 0.60	22.80 ± 0.58	23.53 ± 0.47	23.01 ± 1.18
	T7	24.25 ± 0.85	24.26 ± 0.93	23.65 ± 0.67	24.17 ± 0.71	24.68 ± 0.35	23.81 ± 0.71	23.71 ± 0.71	23.46 ± 0.93	23.66 ± 0.60	23.65 ± 0.59
xLis (mm)	T0	14.25 ± 0.35	13.41 ± 0.94	13.34 ± 0.39	13.48 ± 0.51	13.23 ± 2.61	14.43 ± 0.28	13.62 ± 9.84	14.25 ± 2.07	14.13 ± 0.51	14.65 ± 0.78
	T1	14.90 ± 0.58	14.34 ± 0.56	13.71 ± 1.53	14.35 ± 0.85	14.47 ± 9.86	14.52 ± 2.09	13.62 ± 5.84	13.92 ± 9.07	13.98 ± 0.99	15.02 ± 1.95
	T2	15.93 ± 0.50	14.74 ± 0.61	14.52 ± 2.98	15.02 ± 0.51	15.20 ± 9.63	12.21 ± 1.27	15.34 ± 6.84	12.44 ± 9.07	14.23 ± 1.33	14.01 ± 2.79

	T3	16.67 ± 0.35	14.32 ± 0.91	14.52 ± 3.98	15.08 ± 0.66	15.23 ± 6.58	11.72 ± 1.09	14.67 ± 9.84	11.47 ± 6.07	14.64 ± 1.20	14.48 ± 3.43
	T4	16.95 ± 0.66	15.23 ± 1.07	14.22 ± 4.81	15.93 ± 0.88	16.05 ± 9.06	14.51 ± 0.97	16.23 ± 0.84	13.24 ± 9.07	14.48 ± 1.39	14.49 ± 4.90
	T5	17.89 ± 1.01	15.46 ± 1.55	14.84 ± 5.68	16.09 ± 0.97	16.69 ± 8.38	15.41 ± 1.15	17.10 ± 5.84	14.52 ± 8.07	15.85 ± 1.12	15.75 ± 5.88
	T6	18.77 ± 1.63	16.90 ± 1.86	16.24 ± 6.24	16.80 ± 0.73	17.41 ± 7.50	17.09 ± 0.93	18.47 ± 8.84	16.11 ± 7.07	17.19 ± 0.94	17.11 ± 6.83
	T7	18.95 ± 0.86	18.15 ± 0.74	16.55 ± 7.06	18.29 ± 0.77	18.78 ± 9.45	18.42 ± 1.04	17.90 ± 7.84	17.46 ± 9.07	17.29 ± 0.64	17.30 ± 7.38
ADO1 (mm)	T0	4.96 ± 0.10	4.96 ± 0.61	4.90 ± 0.17	4.73 ± 0.49	4.54 ± 0.27	4.69 ± 0.24	5.90 ± 0.97	5.22 ± 0.43	5.29 ± 0.30	5.20 ± 0.29
	T1	5.41 ± 0.28	5.41 ± 0.47	5.55 ± 0.23	5.28 ± 0.32	5.31 ± 0.35	2.04 ± 8.19	5.90 ± 0.97	5.29 ± 0.61	5.16 ± 0.79	4.39 ± 1.54
	T2	5.66 ± 0.18	5.76 ± 0.34	6.03 ± 0.53	5.50 ± 0.26	5.67 ± 0.14	7.33 ± 1.58	4.52 ± 1.11	7.06 ± 0.94	5.77 ± 1.10	5.67 ± 1.46
	T3	5.74 ± 0.24	6.15 ± 0.43	6.03 ± 0.53	5.59 ± 0.21	5.69 ± 0.34	7.55 ± 0.90	4.41 ± 3.78	8.07 ± 0.81	6.39 ± 0.90	6.12 ± 0.69
	T4	5.61 ± 0.37	6.09 ± 0.11	6.24 ± 0.42	5.64 ± 0.22	5.79 ± 0.37	5.70 ± 0.76	5.29 ± 0.52	6.37 ± 0.95	6.45 ± 0.64	5.81 ± 0.59
	T5	5.88 ± 0.27	6.04 ± 0.42	6.49 ± 0.67	5.85 ± 0.41	5.88 ± 0.38	6.11 ± 0.86	5.73 ± 0.54	6.01 ± 0.61	6.28 ± 0.38	5.83 ± 0.57
	T6	5.95 ± 0.26	6.20 ± 0.42	6.41 ± 0.41	5.70 ± 0.35	5.83 ± 0.35	6.04 ± 0.55	6.28 ± 0.12	5.93 ± 0.41	6.35 ± 0.68	5.90 ± 0.68
	T7	6.18 ± 0.27	6.11 ± 0.41	6.36 ± 0.48	5.88 ± 0.43	5.90 ± 0.58	5.78 ± 0.91	5.80 ± 0.55	6.00 ± 0.96	6.25 ± 0.94	5.98 ± 0.53
MPA (°)	T0	9.12 ± 0.54	9.33 ± 0.56	9.60 ± 0.76	9.47 ± 0.49	8.69 ± 0.66	8.91 ± 0.46	9.65 ± 1.01	9.60 ± 0.77	9.68 ± 0.74	9.31 ± 0.80
	T1	9.03 ± 0.40	9.59 ± 0.50	10.36 ± 0.81	9.17 ± 0.52	9.09 ± 0.46	13.14 ± 0.79	13.90 ± 0.79	14.11 ± 0.33	13.81 ± 1.18	13.59 ± 1.24
	T2	9.13 ± 0.33	10.03 ± 0.50	9.93 ± 0.85	9.26 ± 0.51	9.20 ± 0.39	13.90 ± 1.03	13.44 ± 0.30	16.02 ± 0.79	13.63 ± 1.30	12.95 ± 1.60
	T3	8.68 ± 0.55	10.81 ± 0.65	10.43 ± 0.28	9.62 ± 0.37	9.52 ± 0.75	15.72 ± 2.21	14.67 ± 1.91	16.40 ± 0.13	12.91 ± 1.10	12.33 ± 1.10
	T4	9.13 ± 0.43	10.80 ± 0.96	11.65 ± 1.04	9.59 ± 0.53	9.54 ± 0.45	11.25 ± 0.76	10.27 ± 0.97	12.92 ± 0.75	11.46 ± 1.17	10.98 ± 0.99
	T5	8.57 ± 0.69	10.87 ± 0.90	11.27 ± 0.92	10.07 ± 1.06	9.65 ± 1.01	10.65 ± 0.42	9.60 ± 0.62	12.26 ± 1.84	10.82 ± 0.96	10.49 ± 1.04
	T6	8.75 ± 0.83	11.02 ± 1.34	11.26 ± 0.85	9.74 ± 0.49	9.60 ± 0.24	9.70 ± 0.64	9.86 ± 0.31	11.33 ± 0.54	10.09 ± 0.49	10.06 ± 1.20
	T7	9.64 ± 0.56	10.09 ± 0.80	10.24 ± 0.60	10.02 ± 0.94	9.40 ± 0.00	9.82 ± 0.95	9.98 ± 0.60	10.92 ± 0.05	10.55 ± 0.72	10.41 ± 1.06
PPA (°)	T0	2.93 ± 0.75	3.25 ± 0.38	3.33 ± 0.85	3.50 ± 0.60	3.86 ± 0.83	3.14 ± 0.69	2.11 ± 0.46	2.90 ± 0.83	3.05 ± 0.69	2.62 ± 0.33
	T1	2.38 ± 0.47	3.37 ± 0.14	3.53 ± 0.61	2.79 ± 0.72	2.83 ± 0.65	2.74 ± 0.30	2.36 ± 0.39	2.66 ± 0.48	3.20 ± 0.87	3.02 ± 0.45
	T2	2.24 ± 0.47	3.02 ± 0.45	3.01 ± 0.80	2.53 ± 0.27	2.52 ± 0.25	2.71 ± 0.76	3.26 ± 0.70	3.91 ± 0.83	2.99 ± 0.58	3.59 ± 1.13
	T3	2.22 ± 0.34	2.87 ± 0.27	3.01 ± 0.80	2.76 ± 0.55	2.72 ± 0.61	3.51 ± 1.16	2.43 ± 0.55	3.21 ± 0.94	3.04 ± 0.82	3.07 ± 0.59
	T4	2.48 ± 0.34	3.48 ± 0.97	3.84 ± 1.12	2.70 ± 0.59	2.65 ± 0.76	2.25 ± 0.83	2.44 ± 0.22	3.78 ± 0.97	3.48 ± 1.09	3.21 ± 0.88
	T5	1.93 ± 0.97	2.89 ± 0.41	2.67 ± 0.35	3.08 ± 1.06	2.51 ± 1.64	2.58 ± 1.00	2.51 ± 0.90	3.09 ± 1.21	3.16 ± 0.66	3.17 ± 0.97
	T6	2.02 ± 0.88	2.88 ± 0.81	2.56 ± 0.34	2.71 ± 0.56	2.42 ± 0.82	2.68 ± 0.70	1.99 ± 0.81	3.23 ± 0.38	2.99 ± 0.51	2.86 ± 1.34
	T7	1.91 ± 0.95	2.63 ± 1.01	1.60 ± 0.81	2.47 ± 0.44	2.57 ± 0.50	2.30 ± 0.83	2.60 ± 1.12	3.40 ± 0.74	3.97 ± 0.96	3.77 ± 1.08
AoO (°)	T0	1.87 ± 0.40	1.85 ± 0.22	1.96 ± 0.42	1.90 ± 0.39	2.05 ± 0.34	1.85 ± 0.40	1.99 ± 0.35	1.81 ± 0.22	1.78 ± 0.52	2.16 ± 0.46
	T1	1.83 ± 0.37	2.06 ± 0.24	2.31 ± 0.23	2.03 ± 0.53	2.06 ± 0.37	6.17 ± 0.36	5.81 ± 0.98	6.17 ± 0.34	6.29 ± 1.70	7.07 ± 1.14
	T2	1.79 ± 0.36	2.04 ± 0.20	2.03 ± 0.26	1.74 ± 0.45	2.08 ± 0.30	5.40 ± 0.85	6.58 ± 1.77	7.13 ± 0.90	5.50 ± 1.08	5.65 ± 0.60
	T3	2.06 ± 0.38	2.01 ± 0.28	2.03 ± 0.26	2.02 ± 0.27	1.87 ± 0.60	5.49 ± 1.57	5.89 ± 0.55	6.70 ± 0.28	4.58 ± 1.19	4.41 ± 0.77
	T4	2.15 ± 0.42	1.59 ± 0.33	1.80 ± 0.73	1.59 ± 0.70	1.72 ± 0.97	2.44 ± 1.56	2.57 ± 1.11	3.60 ± 0.89	2.82 ± 0.56	2.39 ± 0.69

	T5	1.66 ± 0.40	2.07 ± 0.58	1.71 ± 0.52	1.74 ± 0.38	1.55 ± 0.39	2.50 ± 0.82	2.38 ± 0.75	2.17 ± 0.44	2.04 ± 0.40	2.19 ± 0.55
	T6	1.77 ± 0.29	1.59 ± 0.32	1.99 ± 0.58	1.64 ± 0.34	1.75 ± 0.44	2.29 ± 0.68	1.94 ± 0.35	2.42 ± 0.61	2.04 ± 0.49	2.68 ± 1.04
	T7	2.14 ± 0.21	2.13 ± 0.60	1.93 ± 0.36	1.97 ± 0.28	2.12 ± 0.53	2.16 ± 0.65	2.04 ± 1.12	2.09 ± 0.41	1.97 ± 0.42	2.34 ± 0.39
Radius (mm)	T0	13.93 ± 0.36	13.44 ± 1.30	13.81 ± 0.39	13.07 ± 1.41	12.81 ± 1.02	14.20 ± 0.68	14.94 ± 0.52	14.75 ± 1.77	14.54 ± 0.82	14.59 ± 0.60
	T1	15.36 ± 0.60	14.88 ± 1.60	15.01 ± 0.50	14.82 ± 1.22	14.84 ± 1.22	14.74 ± 0.66	15.32 ± 0.49	15.35 ± 1.63	15.40 ± 0.74	15.29 ± 0.40
	T2	16.54 ± 0.28	16.05 ± 1.12	16.47 ± 0.37	16.43 ± 0.72	16.41 ± 0.90	15.55 ± 0.65	16.11 ± 0.28	16.42 ± 0.65	16.37 ± 0.76	15.93 ± 0.49
	T3	17.44 ± 0.63	16.70 ± 0.71	16.72 ± 0.21	16.68 ± 0.85	16.88 ± 0.97	16.46 ± 0.41	16.26 ± 0.39	16.91 ± 0.67	16.86 ± 0.70	16.88 ± 0.32
	T4	18.55 ± 1.15	17.71 ± 1.13	17.37 ± 0.64	17.97 ± 0.92	18.14 ± 0.04	17.34 ± 0.78	17.69 ± 0.44	17.51 ± 0.76	17.97 ± 0.66	17.62 ± 0.54
	T5	19.63 ± 0.56	18.52 ± 1.19	18.34 ± 0.66	18.76 ± 0.47	19.37 ± 0.08	18.07 ± 1.19	18.57 ± 0.58	18.52 ± 0.52	19.42 ± 1.05	18.18 ± 0.85
	T6	21.21 ± 0.74	19.65 ± 1.24	19.47 ± 1.54	19.72 ± 0.34	20.43 ± 0.31	20.12 ± 0.81	19.43 ± 1.20	20.46 ± 0.48	20.67 ± 1.12	19.72 ± 0.71
	T7	21.64 ± 1.80	21.36 ± 3.10	19.92 ± 1.93	21.21 ± 3.37	20.93 ± 3.68	20.88 ± 2.84	20.06 ± 1.12	20.76 ± 3.94	20.72 ± 0.77	21.12 ± 1.14

↔ represents distance between, where x represents the perpendicular distance from the y-axis, and y represents the perpendicular distance from the x-axis.

5.2.2.1 LC-LT Anteroposterior Position of the Maxilla (S to Uii)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for S↔Uii are displayed below (Table XXIII). A line graph of the group means and a boxplot of S↔Uii are displayed below in Figures 32 and 33. At T2 the MSLR group had a significantly shorter S↔Uii than the CL group ($p \leq 0.01$). At T3 the ML group had a significantly shorter S↔Uii length than the CL group ($p \leq 0.001$) and the SL and SLR groups ($p \leq 0.01$). The MSL group had a significantly shorter S↔Uii length than the CL, SL, and SLR groups ($p \leq 0.001$). The MSLR group had a significantly shorter S↔Uii length than the CL, SL, SLR, and MBLR groups ($p \leq 0.001$). At T4 the ML group had a significantly shorter S↔Uii length than the CL group ($p \leq 0.001$). At T5 the BLR group had a significantly shorter S↔Uii length than the CL group ($p \leq 0.01$). At T7 the BLR group had a significantly shorter S↔Uii length than the CL group ($p \leq 0.01$). The control group had a greater maxillary projection throughout all timepoints.

Table XXIII: Multiple Comparisons Within Groups LC-LT for S to Uii

Group	Time(I)	Time(J)	Mean (I-J)	Std. Error	Sig.	99% CI		Group	Time(I)	Time(J)	Mean (I-J)	Std. Error	Sig.	99% CI	
*The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-1.12*	0.18	0.00	-1.97	-0.28	ML	0	1	0.06	0.30	1.00	-1.48	1.60
		2	-2.12*	0.23	0.00	-3.24	-1.02			2	-0.39	0.34	1.00	-2.20	1.43
		3	-2.54*	0.28	0.00	-4.01	-1.07			3	-0.25	0.27	1.00	-1.59	1.09
		4	-3.15*	0.26	0.00	-4.50	-1.80			4	-1.14	0.31	0.11	-2.78	0.50
		5	-4.42*	0.20	0.00	-5.37	-3.48			5	-2.41*	0.36	0.00	-4.40	-0.43
		6	-5.54*	0.35	0.00	-7.52	-3.57			6	-4.10*	0.48	0.00	-6.89	-1.32
		7	-6.33*	0.34	0.00	-8.19	-4.48			7	-5.31*	0.45	0.00	-7.93	-2.70
	1	2	-1.00	0.23	0.03	-2.13	0.12		1	2	-0.44	0.41	1.00	-2.36	1.48
		3	-1.42*	0.29	0.01	-2.88	0.05			3	-0.30	0.35	1.00	-1.95	1.34
		4	-2.02*	0.27	0.00	-3.38	-0.67			4	-1.20	0.39	0.19	-3.01	0.61
		5	-3.30*	0.21	0.00	-4.27	-2.33			5	-2.47*	0.43	0.00	-4.51	-0.44
		6	-4.42*	0.36	0.00	-6.38	-2.46			6	-4.16*	0.53	0.00	-6.83	-1.49
		7	-5.21*	0.34	0.00	-7.05	-3.37			7	-5.37*	0.51	0.00	-7.90	-2.85
	2	3	-0.41	0.32	1.00	-1.92	1.10		2	3	0.14	0.39	1.00	-1.71	1.99
		4	-1.02	0.30	0.12	-2.44	0.40			4	-0.76	0.42	0.93	-2.72	1.20
		5	-2.29*	0.25	0.00	-3.46	-1.13			5	-2.03	0.46	0.02	-4.17	0.11
		6	-3.41*	0.38	0.00	-5.35	-1.49			6	-3.71*	0.55	0.00	-6.42	-1.02
		7	-4.20*	0.37	0.00	-6.03	-2.38			7	-4.93*	0.53	0.00	-7.50	-2.36
	3	4	-0.61	0.34	0.94	-2.22	1.00		3	4	-0.90	0.36	0.54	-2.61	0.82
		5	-1.88*	0.30	0.00	-3.36	-0.41			5	-2.16*	0.41	0.01	-4.15	-0.18
		6	-3.00*	0.42	0.00	-5.00	-1.01			6	-3.85*	0.51	0.00	-6.53	-1.18
		7	-3.79*	0.40	0.00	-5.70	-1.89			7	-5.07*	0.49	0.00	-7.59	-2.55
	4	5	-1.28	0.28	0.02	-2.64	0.09		4	5	-1.27	0.44	0.29	-3.34	0.80
		6	-2.39*	0.41	0.00	-4.36	-0.43			6	-2.96*	0.54	0.00	-5.64	-0.28
		7	-3.18*	0.39	0.00	-5.06	-1.32			7	-4.17*	0.52	0.00	-6.71	-1.64
	5	6	-1.12	0.37	0.29	-3.06	0.82		5	6	-1.69	0.57	0.27	-4.42	1.04
		7	-1.91*	0.35	0.01	-3.74	-0.09			7	-2.90*	0.55	0.00	-5.52	-0.29
	6	7	-0.79	0.46	0.96	-2.93	1.34		6	7	-1.21	0.63	0.89	-4.17	1.74
BL	0	1	-1.38	0.63	0.74	-4.39	1.63	MBL	0	1	0.00	0.19	1.00	-0.89	0.89
		2	-2.10	0.59	0.11	-5.05	0.84			2	-0.68	0.22	0.22	-1.73	0.37
		3	-2.12	0.58	0.10	-5.06	0.82			3	-0.84	0.32	0.49	-2.50	0.82
		4	-3.10*	0.64	0.01	-6.17	-0.05			4	-2.16*	0.34	0.00	-4.02	-0.31
		5	-3.31	0.76	0.02	-6.87	0.25			5	-3.49*	0.29	0.00	-4.99	-2.00

		6	-5.04*	0.75	0.00	-8.55	-1.54			6	-4.66*	0.28	0.00	-6.06	-3.27
		7	-6.12*	0.62	0.00	-9.13	-3.12			7	-4.89*	0.21	0.00	-5.91	-3.88
	1	2	-0.73	0.48	0.99	-2.98	1.53		1	2	-0.68	0.22	0.22	-1.73	0.37
		3	-0.74	0.46	0.98	-2.93	1.45			3	-0.84	0.32	0.49	-2.50	0.82
		4	-1.73	0.54	0.17	-4.26	0.80			4	-2.16*	0.34	0.00	-4.02	-0.31
		5	-1.93	0.67	0.33	-5.25	1.38			5	-3.49*	0.29	0.00	-4.99	-2.00
		6	-3.66*	0.66	0.00	-6.90	-0.44			6	-4.66*	0.28	0.00	-6.06	-3.27
		7	-4.74*	0.52	0.00	-7.17	-2.33			7	-4.89*	0.21	0.00	-5.91	-3.88
	2	3	-0.01	0.41	1.00	-1.94	1.91		2	3	-0.16	0.33	1.00	-1.82	1.50
		4	-1.00	0.50	0.85	-3.39	1.38			4	-1.49	0.36	0.05	-3.32	0.35
		5	-1.20	0.64	0.93	-4.50	2.09			5	-2.81*	0.31	0.00	-4.32	-1.30
		6	-2.94	0.63	0.02	-6.14	0.26			6	-3.98*	0.30	0.00	-5.41	-2.56
		7	-4.02*	0.48	0.00	-6.27	-1.77			7	-4.21*	0.24	0.00	-5.34	-3.09
	3	4	-0.99	0.48	0.83	-3.33	1.35		3	4	-1.32	0.42	0.19	-3.31	0.67
		5	-1.19	0.63	0.92	-4.50	2.11			5	-2.64*	0.38	0.00	-4.45	-0.85
		6	-2.93	0.62	0.02	-6.14	0.28			6	-3.82*	0.37	0.00	-5.58	-2.07
		7	-4.00*	0.46	0.00	-6.20	-1.82			7	-4.05*	0.33	0.00	-5.71	-2.40
	4	5	-0.20	0.69	1.00	-3.55	3.15		4	5	-1.33	0.41	0.15	-3.25	0.60
		6	-1.94	0.68	0.32	-5.21	1.33			6	-2.49*	0.40	0.00	-4.39	-0.61
		7	-3.01*	0.54	0.00	-5.54	-0.49			7	-2.73*	0.36	0.00	-4.56	-0.90
	5	6	-1.74	0.79	0.73	-5.43	1.95		5	6	-1.17	0.35	0.13	-2.82	0.47
		7	-2.82	0.67	0.04	-6.13	0.50			7	-1.41	0.31	0.02	-2.91	0.10
	6	7	-1.08	0.66	0.98	-4.31	2.15		6	7	-0.23	0.29	1.00	-1.65	1.18
BLR	0	1	-1.12*	0.21	0.00	-2.11	-0.14	MBLR	0	1	0.28	0.42	1.00	-1.71	2.28
		2	-2.41*	0.25	0.00	-3.58	-1.25			2	-0.21	0.39	1.00	-2.16	1.73
		3	-2.41*	0.25	0.00	-3.58	-1.25			3	-0.56	0.35	0.99	-2.55	1.44
		4	-2.32*	0.32	0.00	-3.90	-0.75			4	-1.51	0.43	0.09	-3.53	0.51
		5	-3.18*	0.33	0.00	-4.84	-1.54			5	-1.85	0.44	0.02	-3.91	0.21
		6	-4.53*	0.40	0.00	-6.67	-2.40			6	-2.83*	0.53	0.00	-5.37	-0.31
		7	-4.98*	0.33	0.00	-6.65	-3.32			7	-4.34*	0.54	0.00	-6.91	-1.78
	1	2	-1.29*	0.23	0.00	-2.40	-0.19		1	2	-0.50	0.33	0.99	-2.06	1.07
		3	-1.29*	0.23	0.00	-2.40	-0.19			3	-0.84	0.28	0.32	-2.33	0.66
		4	-1.20	0.30	0.07	-2.78	0.38			4	-1.78*	0.37	0.01	-3.52	-0.06
		5	-2.06*	0.31	0.00	-3.72	-0.41			5	-2.13*	0.38	0.00	-3.92	-0.35
		6	-3.40*	0.39	0.00	-5.58	-1.24			6	-3.11*	0.49	0.00	-5.55	-0.69
		7	-3.85*	0.32	0.00	-5.54	-2.18			7	-4.62	0.50	0.00	-7.10	-2.15

	2	3	0.00	0.27	1.00	-1.24	1.24		2	3	-0.34	0.24	1.00	-1.58	0.90
		4	0.10	0.33	1.00	-1.50	1.69			4	-1.29	0.34	0.06	-2.92	0.33
		5	-0.77	0.34	0.70	-2.43	0.89			5	-1.64*	0.35	0.01	-3.33	0.06
		6	-2.11*	0.41	0.01	-4.24	0.01			6	-2.62*	0.47	0.01	-5.05	-0.19
		7	-2.56*	0.34	0.00	-4.24	-0.88			7	-4.12*	0.48	0.00	-6.60	-1.65
	3	4	0.10	0.33	1.00	-1.50			3	4	-0.95	0.29	0.23	-2.54	0.63
		5	-0.77	0.34	0.70	-2.43	0.89			5	-1.29	0.30	0.06	-2.98	0.39
		6	-2.11*	0.41	0.01	-4.24	0.01			6	-2.28	0.43	0.02	-4.84	0.27
		7	-2.56*	0.34	0.00	-4.24	-0.88			7	-3.78*	0.44	0.00	-6.39	-1.18
	4	5	-0.87	0.39	0.72	-2.70	0.96		4	5	-0.34	0.39	1.00	-2.17	1.49
		6	-2.20*	0.45	0.01	-4.38	-0.04			6	-1.33	0.50	0.43	-3.77	1.11
		7	-2.65*	0.39	0.00	-4.50	-0.82			7	-2.83*	0.50	0.00	-5.32	-0.35
	5	6	-1.34	0.46	0.29	-3.54	0.85		5	6	-0.99	0.50	0.88	-3.44	1.47
		7	-1.79	0.40	0.02	-3.67	0.09			7	-2.49*	0.51	0.01	-4.99	0.01
	6	7	-0.45	0.46	1.00	-2.65	1.75		6	7	-1.50	0.60	0.50	-4.29	1.28
SL	0	1	-1.49	0.50	0.26	-3.86	0.89	MSL	0	1	0.28	0.43	1.00	-1.78	2.33
		2	-2.35*	0.35	0.00	-4.14	-0.58			2	-0.54	0.41	1.00	-2.45	1.37
		3	-2.71*	0.35	0.00	-4.50	-0.93			3	0.48	0.34	1.00	-1.15	2.12
		4	-3.62*	0.40	0.00	-5.53	-1.72			4	-1.60	0.56	0.35	-4.42	1.22
		5	-4.18*	0.37	0.00	-5.98	-2.39			5	-2.85*	0.43	0.00	-4.88	-0.84
		6	-4.81*	0.35	0.00	-6.60	-3.03			6	-4.37*	0.33	0.00	-5.98	-2.77
		7	-6.40*	0.41	0.00	-8.32	-4.48			7	-4.45*	0.44	0.00	-6.56	-2.36
	1	2	-0.87	0.43	0.88	-3.18	1.44		1	2	-0.82	0.45	0.93	-2.94	1.30
		3	-1.23	0.43	0.39	-3.54	1.09			3	0.21	0.39	1.00	-1.76	2.17
		4	-2.14	0.47	0.02	-4.45	0.18			4	-1.88	0.59	0.19	-4.73	0.98
		5	-2.69*	0.44	0.00	-4.99	-0.41			5	-3.13*	0.47	0.00	-5.34	-0.94
		6	-3.33*	0.43	0.00	-5.65	-1.01			6	-4.65*	0.38	0.00	-6.62	-2.69
		7	-4.91*	0.48	0.00	-7.23	-2.59			7	-4.73*	0.48	0.00	-7.00	-2.48
	2	3	-0.36	0.24	0.99	-1.49	0.77		2	3	1.02	0.36	0.35	-0.74	2.79
		4	-1.26	0.32	0.05	-2.81	0.28			4	-1.06	0.57	0.92	-3.88	1.76
		5	-1.82*	0.26	0.00	-3.07	-0.59			5	-2.32*	0.44	0.00	-4.40	-0.24
		6	-2.45*	0.24	0.00	-3.58	-1.33			6	-3.83*	0.35	0.00	-5.59	-2.09
		7	-4.043*	0.32	0.00	-5.63	-2.46			7	-3.92*	0.46	0.00	-6.08	-1.76
	3	4	-0.91	0.31	0.32	-2.45	0.64		3	4	-2.08	0.52	0.08	-4.94	0.77
		5	-1.46*	0.26	0.00	-2.69	-0.24			5	-3.34*	0.39	0.00	-5.26	-1.43
		6	-2.09*	0.24	0.00	-3.21	-0.99			6	-4.86*	0.27	0.00	-6.13	-3.60

		7	-3.68*	0.32	0.00	-5.27	-2.10
	4	5	-0.56	0.33	0.96	-2.14	1.02
		6	-1.19	0.31	0.07	-2.74	0.35
		7	-2.78*	0.38	0.00	-4.55	-1.01
	5	6	-0.63	0.26	0.57	-1.85	0.59
		7	-2.21*	0.34	0.00	-3.83	-0.60
	6	7	-1.58*	0.32	0.01	-3.17	0.00
SLR	0	1	-1.69	0.45	0.08	-3.92	0.54
		2	-2.74*	0.30	0.00	-4.20	-1.28
		3	-2.91*	0.32	0.00	-4.43	-1.39
		4	-3.84*	0.44	0.00	-5.99	-1.70
		5	-4.67*	0.50	0.00	-7.20	-2.15
		6	-5.50*	0.54	0.00	-8.29	-2.71
		7	-6.90*	0.31	0.00	-8.39	-5.41
	1	2	-1.05	0.42	0.60	-3.28	1.19
		3	-1.22	0.43	0.39	-3.44	1.00
		4	-2.15	0.53	0.03	-4.62	0.32
		5	-2.98*	0.58	0.00	-5.70	-0.27
		6	-3.81*	0.61	0.00	-6.71	-0.91
		7	-5.21*	0.43	0.00	-7.43	-2.99
	2	3	-0.18	0.27	1.00	-1.46	1.11
		4	-1.10	0.40	0.45	-3.23	1.03
		5	-1.94	0.47	0.07	-4.50	0.63
		6	-2.76*	0.51	0.01	-5.62	0.09
		7	-4.16*	0.26	0.00	-5.39	-2.94
	3	4	-0.93	0.42	0.76	-3.05	1.19
		5	-1.76	0.48	0.12	-4.29	0.77
		6	-2.59	0.52	0.02	-5.40	0.22
		7	-3.98*	0.29	0.00	-5.33	-2.65
	4	5	-0.83	0.57	0.99	-3.51	1.84
		6	-1.66	0.60	0.37	-4.53	1.21
		7	-3.06*	0.41	0.00	-5.18	-0.94
	5	6	-0.83	0.65	1.00	-3.86	2.20
		7	-2.23	0.48	0.03	-4.77	0.32
	6	7	-1.40	0.52	0.49	-4.23	1.43

		7	-4.94*	0.40	0.00	-6.96	-2.93
	4	5	-1.26	0.58	0.77	-4.11	1.59
		6	-2.78*	0.52	0.01	-5.66	0.11
		7	-2.86*	0.60	0.01	-5.73	0.01
	5	6	-1.52	0.37	0.05	-3.43	0.39
		7	-1.60	0.48	0.12	-3.83	0.63
	6	7	-0.08	0.39	1.00	-2.10	1.94
MSLR	0	1	0.38	0.37	1.00	-1.37	2.12
		2	0.04	0.35	1.00	-1.63	1.72
		3	1.05	0.31	0.19	-0.60	2.70
		4	-0.75	0.46	0.98	-2.95	1.46
		5	-2.00	0.50	0.05	-4.44	0.43
		6	-3.48*	0.50	0.00	-5.93	-1.05
		7	-4.01*	0.57	0.00	-6.91	-1.12
	1	2	-0.33	0.31	1.00	-1.81	1.14
		3	0.67	0.27	0.60	-0.72	2.06
		4	-1.12	0.44	0.51	-3.27	1.03
		5	-2.38*	0.48	0.01	-4.79	0.03
		6	-3.86*	0.48	0.00	-6.27	-1.45
		7	-4.39*	0.55	0.00	-7.30	-1.49
	2	3	1.01	0.24	0.04	-0.18	2.20
		4	-0.79	0.42	0.92	-2.92	1.35
		5	-2.05	0.46	0.03	-4.46	0.37
		6	-3.52*	0.46	0.00	-5.95	-1.11
		7	-4.05*	0.54	0.00	-6.99	-1.12
	3	4	-1.79	0.39	0.04	-3.98	0.40
		5	-3.05*	0.43	0.00	-5.54	-0.56
		6	-4.53*	0.44	0.00	-7.03	-2.03
		7	-5.06*	0.51	0.00	-8.11	-2.02
	4	5	-1.26	0.55	0.68	-3.85	1.34
		6	-2.74*	0.55	0.01	-5.34	-0.14
		7	-3.27*	0.62	0.00	-6.24	-0.31
	5	6	-1.48	0.59	0.49	-4.22	1.25
		7	-2.01	0.65	0.20	-5.07	1.04
	6	7	-0.53	0.65	1.00	-3.59	2.53

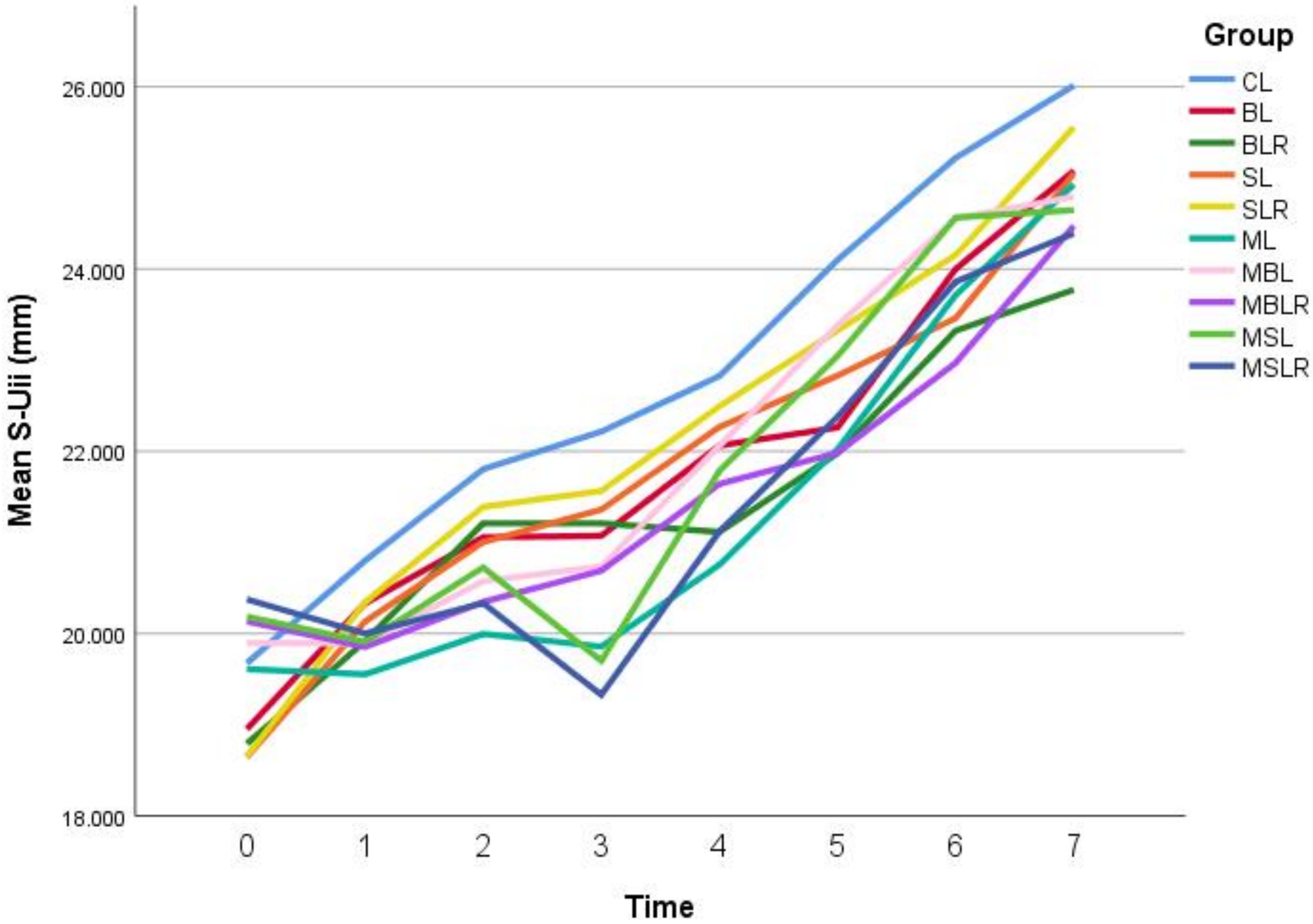


Figure 32: Line Graph of Means of S↔Uii (mm) for LC-LT Groups from T0 to T7

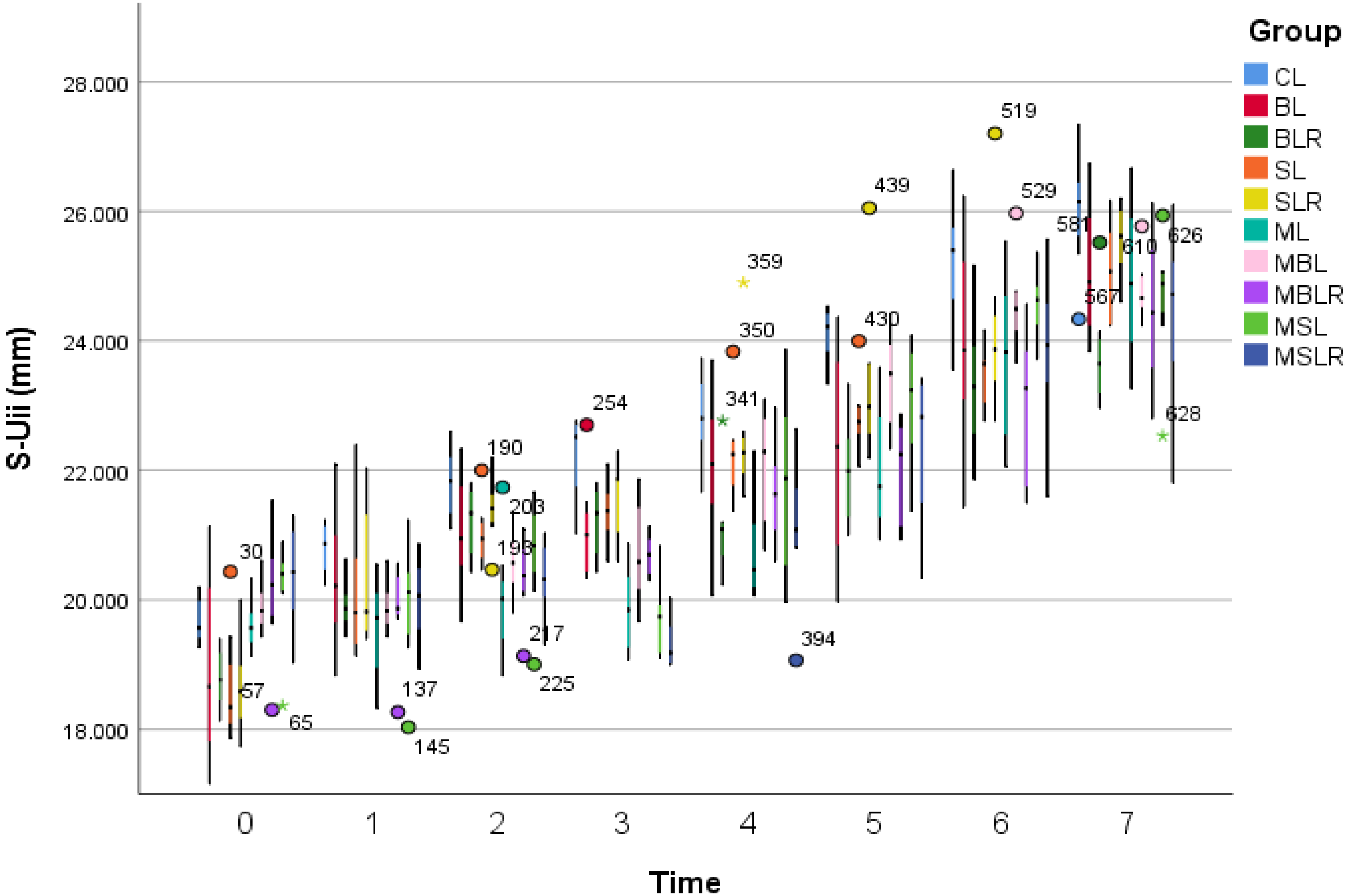


Figure 33: Boxplot of S↔Uii (mm) for LC-LT Groups from T0 to T7

5.2.2.2 LC-LT Length of the Mandibular Ramus (Go to Ag)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Go↔Ag are displayed below (Table XXIV). A line graph of the group means and a boxplot of Go↔Ag are displayed below in Figures 34 and 35. Similarly to the LC-ST groups there were no significant differences between the groups at T0 to T3 for the length of the mandibular ramus. At T4 the BLR and MBLR groups had a significantly shorter ramal length Go↔Ag than the CL and SL group ($p \leq 0.01$). At T5 the BLR and MBLR groups had a significantly shorter Go↔Ag than the CL, SL, and SLR groups ($p \leq 0.01$). At T6 the BLR group had a significantly shorter Go↔Ag than the CL and SL group ($p \leq 0.01$). The MBLR group had a significantly shorter Go↔Ag than the CL group ($p \leq 0.001$). At T7 the BLR group had a significantly shorter Go↔Ag than the CL, SL, and SLR groups ($p \leq 0.001$). The MBLR group had a significantly shorter ramal length Go↔Ag than the CL, SL, and SLR groups ($p \leq 0.01$).

Table XXIV: Multiple Comparisons Within Groups LC-LT for Go to Ag

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.19	0.29	1.00	-1.56	1.17	ML	0	1	-0.11	0.38	1.00	-1.91	1.70
		2	-0.76	0.27	0.35	-2.04	0.52			2	-0.17	0.27	1.00	-1.51	1.18
		3	-1.65*	0.24	0.00	-2.80	-0.51			3	-0.08	0.35	1.00	-1.72	1.56
		4	-2.06*	0.21	0.00	-3.17	-0.96			4	-1.15	0.27	0.03	-2.50	0.20
		5	-2.89*	0.43	0.00	-5.17	-0.61			5	-1.63*	0.34	0.01	-3.22	-0.06
		6	-3.56*	0.27	0.00	-4.81	-2.31			6	-2.28*	0.42	0.00	-4.32	-0.24
		7	-4.29*	0.38	0.00	-6.21	-2.37			7	-2.80*	0.37	0.00	-4.54	-1.07
	1	2	-0.57	0.29	0.89	-1.95	0.81		1	2	-0.06	0.33	1.00	-1.82	1.70
		3	-1.46*	0.27	0.00	-2.75	-0.17			3	0.03	0.40	1.00	-1.84	1.91
		4	-1.87*	0.24	0.00	-3.16	-0.59			4	-1.04	0.33	0.26	-2.79	0.71
		5	-2.70*	0.45	0.00	-4.97	-0.43			5	-1.53	0.39	0.04	-3.36	0.31
		6	-3.31*	0.29	0.00	-4.73	-2.01			6	-2.17*	0.46	0.01	-4.33	-0.01
		7	-4.10*	0.40	0.00	-6.04	-2.17			7	-2.69*	0.41	0.00	-4.63	-0.76
	2	3	-0.90	0.25	0.08	-2.07	0.28		2	3	0.09	0.29	1.00	-1.43	1.62
		4	-1.30*	0.22	0.00	-2.45	-0.16			4	-0.98*	0.20	0.01	-1.90	-0.06
		5	-2.13	0.44	0.02	-4.41	0.15			5	-1.46*	0.28	0.01	-2.90	-0.04
		6	-2.80*	0.27	0.00	-4.08	-1.53			6	-2.11*	0.37	0.01	-4.18	-0.05
		7	-3.53*	0.38	0.00	-5.45	-1.61			7	-2.63*	0.31	0.00	-4.30	-0.98

	3	4	-0.41	0.18	0.68	-1.29	0.46		3	4	-1.07	0.30	0.11	-2.60	0.45
		5	-1.24	0.42	0.37	-3.56	1.08			5	-1.56	0.36	0.02	-3.24	0.12
		6	-1.90*	0.24	0.00	-3.05	-0.77			6	-2.20*	0.44	0.01	-4.29	-0.12
		7	-2.63*	0.36	0.00	-4.57	-0.71			7	-2.72*	0.39	0.00	-4.54	-0.92
	4	5	-0.83	0.40	0.89	-3.23	1.58		4	5	-0.49	0.28	0.97	-1.92	0.95
		6	-1.49*	0.21	0.00	-2.59	-0.40			6	-1.13	0.38	0.33	-3.18	0.92
		7	-2.22*	0.34	0.01	-4.23	-0.23			7	-1.65*	0.32	0.01	-3.31	0.00
	5	6	-0.67	0.43	0.99	-2.95	1.61		5	6	-0.65	0.43	0.99	-2.70	1.41
		7	-1.40	0.51	0.37	-3.81	1.01			7	-1.17	0.38	0.20	-2.94	0.60
	6	7	-0.73	0.38	0.90	-2.65	1.19		6	7	-0.52	0.45	1.00	-2.65	1.60
BL	0	1	-0.71	0.33	0.82	-2.55	1.14	MBL	0	1	0.00	0.25	1.00	-1.19	1.19
		2	-0.70	0.38	0.93	-2.52	1.13			2	-0.86	0.23	0.07	-1.94	0.23
		3	-0.78	0.51	0.99	-3.19	1.63			3	-0.76	0.31	0.57	-2.24	0.73
		4	-1.35	0.51	0.43	-3.77	1.08			4	-1.94*	0.20	0.00	-2.99	-0.90
		5	-1.55	0.59	0.49	-4.52	1.41			5	-2.09*	0.21	0.00	-3.14	-1.05
		6	-2.35*	0.50	0.01	-4.73	0.03			6	-3.23*	0.38	0.00	-5.20	-1.26
		7	-3.00*	0.53	0.00	-5.54	-0.47			7	-3.38*	0.31	0.00	-4.85	-1.92
	1	2	0.01	0.24	1.00	-1.26	1.28		1	2	-0.86	0.23	0.07	-1.94	0.23
		3	-0.07	0.42	1.00	-2.53	2.38			3	-0.76	0.31	0.57	-2.24	0.73
		4	-0.64	0.42	0.99	-3.11	1.83			4	-1.94*	0.20	0.00	-2.99	-0.90
		5	-0.858	0.52	0.99	-4.01	2.32			5	-2.09*	0.21	0.00	-3.14	-1.05
		6	-1.65*	0.41	0.10	-4.05	0.76			6	-3.23*	0.38	0.00	-5.20	-1.26
		7	-2.30	0.44	0.02	-4.92	0.32			7	-3.38*	0.31	0.00	-4.85	-1.92
	2	3	-0.09	0.46	1.00	-2.42	2.25		2	3	0.10	0.29	1.00	-1.36	1.56
		4	-0.65	0.46	1.00	-3.00	1.70			4	-1.09*	0.17	0.00	-1.93	-0.25
		5	-0.86	0.55	0.99	-3.85	2.13			5	-1.24*	0.17	0.00	-2.08	-0.41
		6	-1.66*	0.45	0.10	-3.95	0.63			6	-2.37*	0.37	0.00	-4.37	-0.38
		7	-2.31	0.48	0.02	-4.80	0.17			7	-2.52*	0.28	0.00	-3.96	-1.09
	3	4	-0.57	0.57	1.00	-3.23	2.09		3	4	-1.19	0.27	0.04	-2.67	0.29
		5	-0.77	0.65	1.00	-3.85	2.30			5	-1.34	0.27	0.02	-2.82	0.14
		6	-1.57	0.56	0.33	-4.20	1.06			6	-2.47*	0.42	0.00	-4.50	-0.46
		7	-2.23	0.59	0.05	-4.97	0.51			7	-2.62*	0.35	0.00	-4.27	-0.99
	4	5	-0.21	0.65	1.00	-3.29	2.88		4	5	-0.15	0.14	1.00	-0.81	0.50
		6	-1.01	0.56	0.94	-3.64	1.63			6	-1.29	0.35	0.16	-3.35	0.77
		7	-1.66	0.59	0.32	-4.41	1.09			7	-1.44*	0.27	0.01	-2.90	0.02
		6	-0.80	0.64	1.00	-3.86	2.26			6	-1.13	0.35	0.29	-3.19	0.92

	5	7	-1.46	0.66	0.74	-4.59	1.68		5	7	-1.29	0.27	0.02	-2.74	0.17
	6	7	-0.66	0.58	1.00	-3.38	2.06		6	7	-0.15	0.42	1.00	-2.16	1.86
BLR	0	1	-0.15	0.13	1.00	-0.80	0.49	MBLR	0	1	0.19	0.27	1.00	-1.07	1.44
		2	-0.96	0.21	0.03	-2.09	0.16			2	0.13	0.25	1.00	-1.03	1.28
		3	-0.71	0.32	0.79	-2.60	1.17			3	0.00	0.34	1.00	-1.72	1.72
		4	-0.95	0.21	0.05	-2.14	0.24			4	-0.18	0.35	1.00	-1.93	1.57
		5	-0.70	0.19	0.12	-1.73	0.32			5	-0.48	0.28	0.97	-1.84	0.88
		6	-1.26*	0.17	0.00	-2.18	-0.36			6	-1.52*	0.28	0.00	-2.85	-0.19
		7	-1.76*	0.20	0.00	-2.87	-0.66			7	-2.19*	0.20	0.00	-3.20	-1.18
	1	2	-0.81	0.22	0.09	-1.92	0.30		1	2	-0.06	0.27	1.00	-1.32	1.20
		3	-0.56	0.33	0.97	-2.39	1.27			3	-0.18	0.36	1.00	-1.92	1.56
		4	-0.80	0.23	0.13	-1.96	0.37			4	-0.37	0.36	1.00	-2.14	1.40
		5	-0.55	0.21	0.44	-1.57	0.47			5	-0.67	0.30	0.73	-2.09	0.75
		6	-1.11*	0.19	0.00	-2.04	-0.19			6	-1.70*	0.30	0.00	-3.11	-0.31
		7	-1.61*	0.22	0.00	-2.70	-0.53			7	-2.37*	0.23	0.00	-3.55	-1.20
	2	3	0.25	0.36	1.00	-1.54	2.04		2	3	-0.12	0.34	1.00	-1.84	1.60
		4	0.01	0.28	1.00	-1.28	1.31			4	-0.31	0.35	1.00	-2.06	1.45
		5	0.26	0.26	1.00	-0.95	1.47			5	-0.61	0.29	0.79	-1.97	0.76
		6	-0.30	0.25	1.00	-1.47	0.86			6	-1.64*	0.28	0.00	-2.99	-0.31
		7	-0.80	0.27	0.24	-2.05	0.45			7	-2.31*	0.21	0.00	-3.35	-1.29
	3	4	-0.24	0.37	1.00	-2.03	1.56		3	4	-0.18	0.42	1.00	-2.16	1.79
		5	0.01	0.35	1.00	-1.77	1.79			5	-0.48	0.37	1.00	-2.26	1.29
		6	-0.55	0.34	0.99	-2.34	1.23			6	-1.53	0.37	0.03	-3.29	0.24
		7	-1.05	0.36	0.31	-2.84	0.74			7	-2.19*	0.31	0.00	-3.96	-0.43
	4	5	0.25	0.27	1.00	-1.00	1.50		4	5	-0.30	0.38	1.00	-2.10	1.50
		6	-0.32	0.25	1.00	-1.53	0.89			6	-1.34	0.37	0.09	-3.13	0.45
		7	-0.82	0.27	0.25	-2.10	0.47			7	-2.01*	0.32	0.00	-3.81	-0.21
	5	6	-0.56	0.23	0.59	-1.66	0.54		5	6	-1.04	0.32	0.14	-2.52	0.44
		7	-1.06	0.26	0.03	-2.26	0.14			7	-1.71*	0.25	0.00	-3.03	-0.39
	6	7	-0.50	0.24	0.83	-1.65	0.65		6	7	-0.67	0.25	0.44	-1.96	0.61
SL	0	1	-0.98	0.31	0.20	-2.48	0.52	MSL	0	1	-0.02	0.39	1.00	-1.85	1.81
		2	-1.68*	0.30	0.00	-3.09	-0.28			2	-0.58	0.39	0.99	-2.41	1.25
		3	-1.73*	0.25	0.00	-2.92	-0.55			3	-0.52	0.42	1.00	-2.49	1.45
		4	-2.89*	0.29	0.00	-4.26	-1.53			4	-0.94	0.40	0.64	-2.82	0.95
		5	-3.30*	0.29	0.00	-4.67	-1.95			5	-2.06*	0.42	0.01	-4.01	-0.12
		6	-3.29*	0.29	0.00	-4.64	-1.94			6	-3.06*	0.45	0.00	-5.22	-0.92

		7	-5.09*	0.25	0.00	-6.28	-3.91			7	-3.59*	0.42	0.00	-5.56	-1.64
	1	2	-0.71	0.34	0.80	-2.29	0.88		1	2	-0.56	0.38	0.99	-2.36	1.23
		3	-0.75	0.30	0.53	-2.21	0.71			3	-0.50	0.41	1.00	-2.44	1.44
		4	-1.91*	0.33	0.00	-3.47	-0.36			4	-0.92	0.40	0.64	-2.77	0.93
		5	-2.32*	0.33	0.00	-3.88	-0.77			5	-2.04*	0.41	0.01	-3.97	-0.13
		6	-2.30*	0.33	0.00	-3.85	-0.76			6	-3.05*	0.45	0.00	-5.18	-0.92
		7	-4.11*	0.30	0.00	-5.57	-2.66			7	-3.58*	0.41	0.00	-5.51	-1.66
	2	3	-0.05	0.28	1.00	-1.39	1.30		2	3	0.06	0.41	1.00	-1.88	2.01
		4	-1.21	0.31	0.05	-2.68	0.26			4	-0.36	0.40	1.00	-2.21	1.50
		5	-1.61*	0.31	0.00	-3.09	-0.15			5	-1.48	0.41	0.08	-3.40	0.44
		6	-1.60*	0.31	0.00	-3.07	-0.14			6	-2.48*	0.45	0.00	-4.62	-0.35
		7	-3.40*	0.28	0.00	-4.76	-2.06			7	-3.01*	0.41	0.00	-4.95	-1.09
	3	4	-1.16	0.27	0.03	-2.46	0.13		3	4	-0.42	0.42	1.00	-2.40	1.56
		5	-1.57*	0.27	0.00	-2.87	-0.28			5	-1.55	0.44	0.09	-3.59	0.49
		6	-1.55*	0.27	0.00	-2.84	-0.28			6	-2.55*	0.47	0.00	-4.77	-0.33
		7	-3.36*	0.23	0.00	-4.43	-2.29			7	-3.08*	0.44	0.00	-5.13	-1.04
	4	5	-0.41	0.31	1.00	-1.84	1.02		4	5	-1.13	0.42	0.39	-3.09	0.83
		6	-0.40	0.30	1.00	-1.82	1.03			6	-2.13*	0.46	0.01	-4.30	0.03
		7	-2.20*	0.27	0.00	-3.50	-0.90			7	-2.66*	0.42	0.00	-4.63	-0.69
	5	6	0.02	0.30	1.00	-1.41	1.44		5	6	-1.00	0.47	0.77	-3.21	1.20
		7	-1.78*	0.27	0.00	-3.08	-0.49			7	-1.53	0.43	0.09	-3.56	0.49
	6	7	-1.80*	0.27	0.00	-3.09	-0.52		6	7	-0.53	0.47	1.00	-2.74	1.68
SLR	0	1	-0.91*	0.20	0.01	-1.85	0.03	MSLR	0	1	-0.34	0.42	1.00	-2.35	1.68
		2	-1.50*	0.26	0.00	-2.77	-0.25			2	-0.52	0.36	0.99	-2.20	1.16
		3	-2.04*	0.20	0.00	-2.97	-1.12			3	-0.68	0.33	0.81	-2.23	0.87
		4	-2.62*	0.26	0.00	-3.91	-1.34			4	-1.72*	0.34	0.01	-3.32	-0.14
		5	-3.29*	0.34	0.00	-5.13	-1.45			5	-1.86*	0.33	0.00	-3.41	-0.33
		6	-3.78*	0.39	0.00	-5.95	-1.61			6	-2.98*	0.42	0.00	-4.98	-0.99
		7	-4.99*	0.31	0.00	-6.62	-3.37			7	-3.55*	0.36	0.00	-5.25	-1.86
	1	2	-0.60	0.26	0.67	-1.87	0.67		1	2	-0.19	0.43	1.00	-2.22	1.85
		3	-1.13*	0.20	0.00	-2.09	-0.18			3	-0.35	0.40	1.00	-2.33	1.63
		4	-1.72*	0.26	0.00	-3.01	-0.43			4	-1.39	0.41	0.13	-3.39	0.60
		5	-2.38*	0.35	0.00	-4.22	-0.55			5	-1.53	0.40	0.07	-3.51	0.45
		6	-2.87*	0.39	0.00	-5.03	-0.72			6	-2.64*	0.48	0.00	-4.87	-0.42
		7	-4.08*	0.32	0.00	-5.71	-2.46			7	-3.21*	0.43	0.00	-5.26	-1.17
		3	-0.54	0.26	0.83	-1.80	0.73			3	-0.16	0.34	1.00	-1.75	1.43

	2	4	-1.12	0.31	0.07	-2.56	0.32		2	4	-1.21*	0.35	0.10	-2.84	0.43
		5	-1.79*	0.38	0.01	-3.63	0.06			5	-1.34	0.33	0.04	-2.93	0.24
		6	-2.27*	0.42	0.01	-4.40	-0.15			6	-2.45*	0.42	0.00	-4.47	-0.45
		7	-3.48*	0.35	0.00	-5.16	-1.80			7	-3.03*	0.37	0.00	-4.76	-1.30
	3	4	-0.58*	0.26	0.73	-1.87	0.71		3	4	-1.05	0.32	0.14	-2.53	0.43
		5	-1.25	0.34	0.13	-3.09	0.59			5	-1.19	0.30	0.04	-2.59	0.22
		6	-1.74	0.39	0.04	-3.90	0.42			6	-2.29*	0.40	0.00	-4.25	-0.35
		7	-2.94*	0.31	0.00	-4.57	-1.32			7	-2.87*	0.34	0.00	-4.48	-1.26
	4	5	-0.67	0.38	0.96	-2.52	1.19		4	5	-0.14	0.31	1.00	-1.61	1.33
		6	-1.15	0.43	0.43	-3.28	0.97			6	-1.25	0.41	0.23	-3.22	0.72
		7	-2.36*	0.36	0.00	-4.05	-0.68			7	-1.82*	0.35	0.00	-3.48	-0.17
	5	6	-0.49	0.48	1.00	-2.75	1.78		5	6	-1.11	0.40	0.36	-3.07	0.84
		7	-1.70	0.42	0.03	-3.67	0.27			7	-1.68*	0.34	0.01	-3.29	-0.08
	6	7	-1.21	0.46	0.44	-3.40	0.98		6	7	-0.57	0.43	1.00	-2.59	1.45

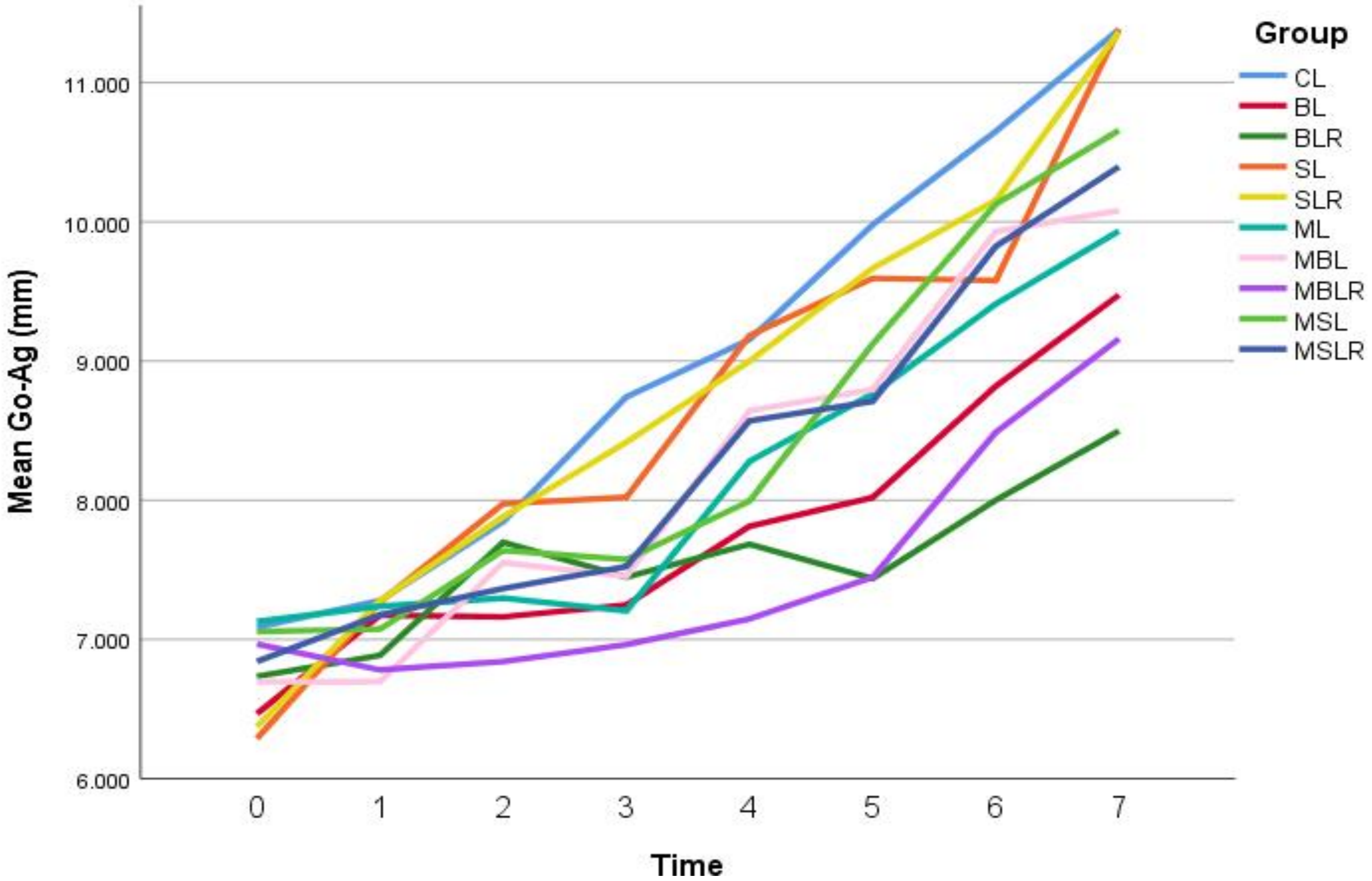


Figure 34: Line Graph of mean Go↔Ag (mm) for LC-LT Groups from T0 to T7

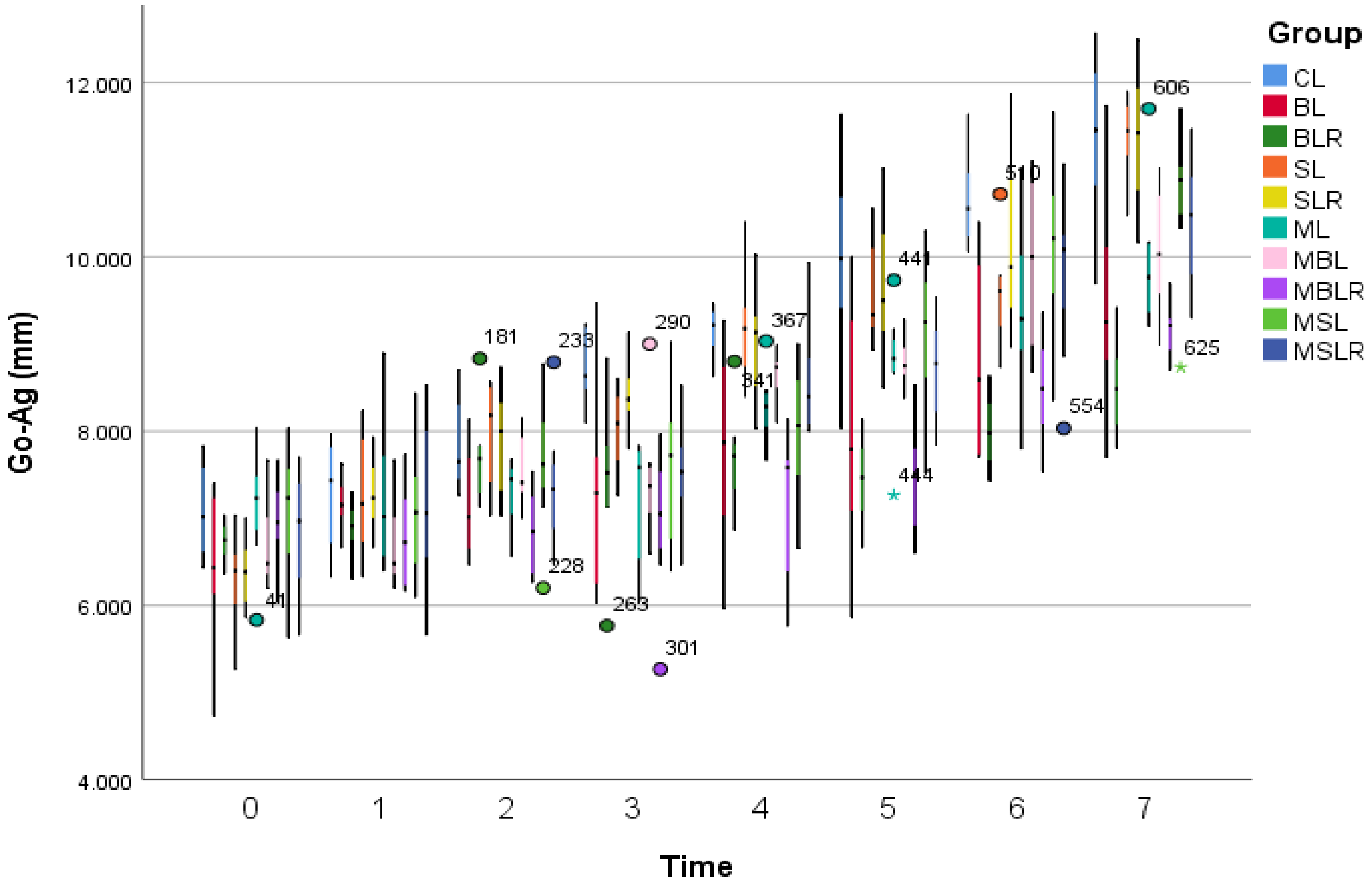


Figure 35: Boxplot of Go↔Ag (mm) for LC-LT Groups from T0 to T7

5.2.2.3 LC-LT Length of the Lower Border of Mandible (Go to Lii)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Go↔Lii are displayed below (Table XXV). A line graph of the group means and a boxplot of Go↔Lii are displayed below in Figures 36 and 37. Similarly to the LC-ST groups there were no significant differences between the groups at T0 to T3 for the length of the lower border of the mandible. The BLR and MBLR groups at T3 actually showed a mean reduction in Go↔Lii from T2 however they had a large range of values for this timepoint. At T4 the BLR group had a significantly shorter Go↔Lii than the CL, SL, SLR, and ML groups ($p \leq 0.001$). The MBLR group had a significantly shorter Go↔Lii than the CL and SL groups ($p \leq 0.01$). At T5 the BLR group had a significantly shorter Go↔Lii than the CL, SL, and SLR groups ($p \leq 0.01$). The MBLR group had a significantly shorter Go↔Lii than the CL, SL, and SLR groups ($p \leq 0.001$). At T6 and T7 there were no significant differences between the groups.

Table XXV: Multiple Comparisons Within Groups LC-LT for Go to Lii

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.87	0.32	0.39	-2.37	0.64	ML	0	1	-0.65	0.37	0.95	-2.42	1.12
		2	-1.98*	0.26	0.00	-3.32	-0.65			2	-0.83	0.36	0.65	-2.57	0.90
		3	-2.38*	0.28	0.00	-3.74	-1.03			3	-0.85	0.40	0.76	-2.70	1.01
		4	-3.45*	0.33	0.00	-5.03	-1.92			4	-2.28*	0.35	0.00	-4.01	-0.56
		5	-4.62*	0.38	0.00	-6.45	-2.80			5	-2.17*	0.43	0.01	-4.18	-0.18
		6	-4.92*	0.29	0.00	-6.30	-3.55			6	-3.24*	0.44	0.00	-5.28	-1.21
		7	-6.31*	0.30	0.00	-7.73	-4.90			7	-4.52*	0.33	0.00	-6.24	-2.81
	1	2	-1.12	0.26	0.03	-2.43	0.19		1	2	-0.19	0.30	1.00	-1.59	1.22
		3	-1.51*	0.28	0.00	-2.85	-0.18			3	-0.20	0.34	1.00	-1.82	1.42
		4	-2.60*	0.33	0.00	-4.15	-1.07			4	-1.63*	0.29	0.00	-3.02	-0.26
		5	-3.75*	0.38	0.00	-5.58	-1.94			5	-1.53	0.38	0.04	-3.36	0.31
		6	-4.06*	0.29	0.00	-5.42	-2.70			6	-2.59*	0.39	0.00	-4.48	-0.71
		7	-5.45*	0.30	0.00	-6.85	-4.05			7	-3.87*	0.27	0.00	-5.20	-2.56
	2	3	-0.39	0.20	0.89	-1.37	0.58		2	3	-0.01	0.33	1.00	-1.59	1.56
		4	-1.48*	0.27	0.01	-2.89	-0.09			4	-1.45*	0.28	0.00	-2.74	-0.16
		5	-2.63*	0.33	0.00	-4.44	-0.83			5	-1.34	0.37	0.09	-3.15	0.47
		6	-2.94*	0.21	0.00	-3.98	-1.90			6	-2.40*	0.38	0.00	-4.28	-0.54
		7	-4.33*	0.23	0.00	-5.46	-3.20			7	-3.69*	0.26	0.00	-4.90	-2.48
	3	4	-1.09	0.29	0.07	-2.50	0.32		3	4	-1.44	0.32	0.02	-3.00	0.12

		5	-2.24*	0.35	0.00	-4.02	-0.47			5	-1.33	0.41	0.15	-3.24	0.58
		6	-2.54*	0.24	0.00	-3.66	-1.43			6	-2.39*	0.41	0.00	-4.35	-0.44
		7	-3.93*	0.25	0.00	-5.13	-2.74			7	-3.67*	0.31	0.00	-5.21	-2.15
	4	5	-1.15	0.39	0.26	-3.00	0.70		4	5	0.11	0.36	1.00	-1.70	1.91
		6	-1.45*	0.30	0.01	-2.88	-0.02			6	-0.96	0.37	0.51	-2.82	0.90
		7	-2.84*	0.31	0.00	-4.30	-1.38			7	-2.24*	0.25	0.00	-3.41	-1.08
	5	6	-0.30	0.35	1.00	-2.08	1.47		5	6	-1.07	0.44	0.59	-3.15	1.01
		7	-1.69	0.36	0.02	-3.48	0.09			7	-2.34*	0.35	0.00	-4.15	-0.55
	6	7	-1.39*	0.26	0.00	-2.62	-0.16		6	7	-1.28	0.36	0.12	-3.15	0.58
BL	0	1	-1.31	0.57	0.71	-4.24	1.63	MBL	0	1	0.00	0.27	1.00	-1.26	1.26
		2	-1.96	0.55	0.14	-4.93	1.00			2	-1.49*	0.27	0.00	-2.76	-0.22
		3	-2.18	0.55	0.08	-5.15	0.79			3	-0.62	0.51	1.00	-3.41	2.17
		4	-2.75	0.62	0.02	-5.73	0.24			4	-1.96*	0.22	0.00	-3.07	-0.85
		5	-3.15	0.71	0.02	-6.48	0.17			5	-2.57*	0.26	0.00	-3.77	-1.37
		6	-4.41*	0.69	0.00	-7.63	-1.21			6	-4.33*	0.29	0.00	-5.70	-2.98
		7	-5.69*	0.63	0.00	-8.69	-2.69			7	-5.18*	0.36	0.00	-6.97	-3.40
	1	2	-0.66	0.34	0.88	-2.25	0.94		1	2	-1.49*	0.27	0.00	-2.76	-0.22
		3	-0.88	0.33	0.45	-2.46	0.71			3	-0.62	0.51	1.00	-3.41	2.17
		4	-1.44	0.44	0.16	-3.55	0.68			4	-1.96*	0.22	0.00	-3.07	-0.85
		5	-1.85	0.57	0.20	-4.77	1.08			5	-2.57*	0.26	0.00	-3.77	-1.37
		6	-3.11*	0.53	0.00	-5.81	-0.41			6	-4.33	0.29	0.00	-5.70	-2.98
		7	-4.38*	0.45	0.00	-6.58	-2.18			7	-5.18*	0.36	0.00	-6.97	-3.40
	2	3	-0.22	0.30	1.00	-1.62	1.18		2	3	0.87	0.51	0.97	-1.92	3.66
		4	-0.78	0.42	0.92	-2.85	1.29			4	-0.47	0.22	0.80	-1.59	0.65
		5	-1.19	0.55	0.80	-4.15	1.77			5	-1.08	0.26	0.03	-2.28	0.12
		6	-2.46	0.51	0.02	-5.17	0.26			6	-2.87*	0.29	0.00	-4.21	-1.49
		7	-3.72*	0.43	0.00	-5.89	-1.56			7	-3.69*	0.36	0.00	-5.48	-1.90
	3	4	-0.56	0.41	1.00	-2.63	1.51		3	4	-1.34	0.48	0.51	-4.26	1.58
		5	-0.97	0.54	0.96	-3.93	1.99			5	-1.95	0.50	0.10	-4.77	0.87
		6	-2.24	0.51	0.04	-4.96	0.48			6	-3.71*	0.52	0.00	-6.48	-0.96
		7	-3.50*	0.43	0.00	-5.67	-1.34			7	-4.55*	0.56	0.00	-7.32	-1.80
	4	5	-0.41	0.62	1.00	-3.38	2.57		4	5	-0.61	0.20	0.26	-1.60	0.38
		6	-1.67	0.58	0.31	-4.46	1.12			6	-2.37*	0.24	0.00	-3.65	-1.11
		7	-2.94*	0.51	0.00	-5.35	-0.54			7	-3.21*	0.32	0.00	-5.05	-1.39
	5	6	-1.27	0.68	0.92	-4.47	1.94		5	6	-1.75*	0.28	0.00	-3.08	-0.46
		7	-2.54	0.63	0.04	-5.54	0.46			7	-2.60*	0.35	0.00	-4.39	-0.83

	6	7	-1.27	0.60	0.77	-4.09	1.55		6	7	-0.84	0.38	0.71	-2.65	0.97
BLR	0	1	-0.77	0.27	0.37	-2.19	0.64	MBLR	0	1	-0.47	0.34	1.00	-2.11	1.18
		2	-1.17	0.28	0.06	-2.70	0.36			2	-0.42	0.36	1.00	-2.14	1.30
		3	-1.66*	0.24	0.00	-2.89	-0.45			3	0.41	0.50	1.00	-2.04	2.86
		4	-1.05	0.31	0.18	-2.72	0.62			4	-0.90	0.40	0.70	-2.80	0.99
		5	-2.06*	0.37	0.01	-4.17	0.04			5	-1.49	0.35	0.03	-3.18	0.20
		6	-3.80*	0.29	0.00	-5.39	-2.22			6	-3.46*	0.48	0.00	-5.80	-1.14
		7	-5.47*	0.24	0.00	-6.68	-4.28			7	-4.51*	0.40	0.00	-6.41	-2.63
	1	2	-0.39	0.36	1.00	-2.06	1.27		1	2	0.05	0.30	1.00	-1.36	1.46
		3	-0.89	0.32	0.34	-2.40	0.61			3	0.88	0.46	0.92	-1.57	3.32
		4	-0.28	0.37	1.00	-2.03	1.47			4	-0.44	0.35	1.00	-2.14	1.26
		5	-1.29	0.43	0.25	-3.36	0.77			5	-1.02	0.29	0.08	-2.37	0.32
		6	-3.03*	0.36	0.00	-4.73	-1.33			6	-3.00*	0.43	0.00	-5.30	-0.70
		7	-4.70*	0.32	0.00	-6.21	-3.21			7	-4.05*	0.34	0.00	-5.75	-2.35
	2	3	-0.50	0.33	0.99	-2.08	1.08		2	3	0.83	0.48	0.96	-1.60	3.25
		4	0.11	0.38	1.00	-1.69	1.91			4	-0.49	0.37	1.00	-2.26	1.28
		5	-0.90	0.44	0.83	-2.99	1.19			5	-1.08	0.32	0.12	-2.56	0.41
		6	-2.63*	0.38	0.00	-4.39	-0.88			6	-3.05	0.46	0.00	-5.34	-0.77
		7	-4.31*	0.33	0.00	-5.89	-2.73			7	-4.10*	0.37	0.00	-5.87	-2.34
	3	4	0.61	0.35	0.96	-1.07	2.30		3	4	-1.31	0.51	0.48	-3.77	1.14
		5	-0.40	0.41	1.00	-2.44	1.64			5	-1.90	0.47	0.06	-4.32	0.52
		6	-2.13*	0.34	0.00	-3.76	-0.51			6	-3.87*	0.57	0.00	-6.56	-1.20
		7	-3.81*	0.29	0.00	-5.19	-2.44			7	-4.92*	0.51	0.00	-7.39	-2.47
	4	5	-1.01	0.45	0.70	-3.14	1.12		4	5	-0.59	0.36	0.98	-2.33	1.15
		6	-2.75*	0.39	0.00	-4.58	-0.92			6	-2.56*	0.49	0.01	-4.91	-0.22
		7	-4.42*	0.35	0.00	-6.11	-2.74			7	-3.61*	0.41	0.00	-5.54	-1.69
	5	6	-1.74	0.44	0.05	-3.85	0.37		5	6	-1.98	0.45	0.03	-4.26	0.31
		7	-3.41*	0.41	0.00	-5.45	-1.38			7	-3.02*	0.36	0.00	-4.76	-1.29
	6	7	-1.67*	0.34	0.01	-3.30	-0.05		6	7	-1.05	0.49	0.77	-3.39	1.30
SL	0	1	-1.70	0.54	0.18	-4.22	0.82	MSL	0	1	-0.80	0.39	0.82	-2.63	1.03
		2	-2.78*	0.51	0.00	-5.20	-0.37			2	-1.43	0.47	0.26	-3.77	0.91
		3	-3.17*	0.46	0.00	-5.50	-0.86			3	-1.34	0.48	0.39	-3.73	1.06
		4	-4.27*	0.49	0.00	-6.64	-1.91			4	-1.34	0.41	0.15	-3.28	0.60
		5	-4.63*	0.43	0.00	-6.99	-2.28			5	-2.76*	0.42	0.00	-4.74	-0.79
		6	-5.63*	0.46	0.00	-7.96	-3.32			6	-4.26*	0.36	0.00	-5.97	-2.56
		7	-7.07*	0.48	0.00	-9.42	-4.73			7	-5.11*	0.36	0.00	-6.82	-3.41

	1	2	-1.09	0.48	0.68	-3.35	1.17		1	2	-0.63	0.50	1.00	-3.02	1.76
		3	-1.48	0.43	0.13	-3.60	0.63			3	-0.53	0.51	1.00	-2.97	1.91
		4	-2.58*	0.46	0.00	-4.77	-0.39			4	-0.54	0.44	1.00	-2.58	1.50
		5	-2.93*	0.40	0.00	-5.06	-0.81			5	-1.96	0.44	0.02	-4.04	0.11
		6	-3.94*	0.43	0.00	-6.06	-1.82			6	-3.46*	0.39	0.00	-5.32	-1.61
		7	-5.37*	0.45	0.00	-7.54	-3.22			7	-4.30*	0.39	0.00	-6.16	-2.46
	2	3	-0.39	0.39	1.00	-2.28	1.50		2	3	0.10	0.57	1.00	-2.59	2.78
		4	-1.49*	0.43	0.10	-3.50	0.52			4	0.09	0.51	1.00	-2.34	2.52
		5	-1.85*	0.36	0.01	-3.69	0.00			5	-1.33	0.52	0.47	-3.78	1.12
		6	-2.85*	0.39	0.00	-4.74	-0.96			6	-2.83*	0.48	0.00	-5.18	-0.49
		7	-4.28*	0.42	0.00	-6.25	-2.33			7	-3.68*	0.48	0.00	-6.03	-1.33
	3	4	-1.10	0.37	0.26	-2.86	0.66		3	4	-0.01	0.52	1.00	-2.49	2.47
		5	-1.45*	0.28	0.01	-2.83	-0.07			5	-1.43	0.53	0.39	-3.93	1.07
		6	-2.45*	0.33	0.00	-4.01	-0.91			6	-2.93*	0.49	0.00	-5.34	-0.53
		7	-3.89*	0.36	0.00	-5.58	-2.21			7	-3.77*	0.49	0.00	-6.18	-1.37
	4	5	-0.35	0.33	1.00	-2.03	1.33		4	5	-1.42	0.46	0.20	-3.57	0.73
		6	-1.36	0.37	0.08	-3.12	0.40			6	-2.92*	0.41	0.00	-4.88	-0.96
		7	-2.79*	0.40	0.00	-4.65	-0.95			7	-3.76*	0.41	0.00	-5.73	-1.81
	5	6	-1.01*	0.28	0.10	-2.39	0.38		5	6	-1.50	0.42	0.09	-3.50	0.49
		7	-2.44*	0.31	0.00	-4.02	-0.87			7	-2.34*	0.42	0.00	-4.34	-0.35
	6	7	-1.44	0.36	0.04	-3.12	0.25		6	7	-0.85	0.37	0.67	-2.58	0.89
SLR	0	1	-2.06	0.52	0.04	-4.52	0.40	MSLR	0	1	-1.32	0.38	0.10	-3.12	0.48
		2	-3.09*	0.41	0.00	-5.09	-1.10			2	-1.00	0.47	0.80	-3.38	1.38
		3	-3.26*	0.38	0.00	-5.24	-1.28			3	-1.42	0.42	0.13	-3.45	0.61
		4	-4.49*	0.51	0.00	-6.89	-2.10			4	-2.02*	0.34	0.00	-3.62	-0.42
		5	-5.26*	0.49	0.00	-7.55	-2.97			5	-2.65*	0.38	0.00	-4.49	-0.82
		6	-5.57*	0.36	0.00	-7.62	-3.52			6	-3.87*	0.45	0.00	-6.10	-1.65
		7	-6.93*	0.39	0.00	-8.92	-4.96			7	-4.75*	0.28	0.00	-6.11	-3.40
	1	2	-1.04	0.46	0.72	-3.34	1.27		1	2	0.32	0.51	1.00	-2.11	2.75
		3	-1.20	0.43	0.44	-3.53	1.13			3	-0.10	0.46	1.00	-2.24	2.05
		4	-2.43	0.55	0.02	-5.00	0.14			4	-0.70	0.39	0.94	-2.54	1.14
		5	-3.19*	0.53	0.00	-5.68	-0.71			5	-1.33	0.43	0.19	-3.33	0.67
		6	-3.50*	0.41	0.00	-5.93	-1.08			6	-2.54*	0.48	0.00	-4.85	-0.24
		7	-4.87*	0.44	0.00	-7.18	-2.57			7	-3.43*	0.33	0.00	-5.17	-1.69
	2	3	-0.16	0.28	1.00	-1.52	1.19		2	3	-0.42	0.53	1.00	-2.94	2.10
		4	-1.40	0.44	0.22	-3.62	0.82			4	-1.02	0.48	0.80	-3.40	1.36

		5	-2.16*	0.42	0.01	-4.22	-0.11			5	-1.65	0.51	0.17	-4.09	0.79
		6	-2.47*	0.25	0.00	-3.79	-1.15			6	-2.87*	0.56	0.00	-5.49	-0.25
		7	-3.83*	0.30	0.00	-5.25	-2.43			7	-3.75*	0.44	0.00	-6.18	-1.32
	3	4	-1.23	0.42	0.35	-3.47	1.00		3	4	-0.60	0.43	1.00	-2.65	1.45
		5	-2.00*	0.39	0.01	-4.05	0.05			5	-1.23	0.46	0.40	-3.40	0.93
		6	-2.30*	0.20	0.00	-3.31	-1.31			6	-2.45*	0.51*	0.01	-4.86	-0.04
		7	-3.67*	0.26	0.00	-4.91	-2.45			7	-3.33*	0.38	0.00	-5.36	-1.31
	4	5	-0.77	0.52	0.99	-3.19	1.66		4	5	-0.63	0.40	0.98	-2.50	1.24
		6	-1.08	0.40	0.53	-3.40	1.25			6	-1.85	0.46	0.04	-4.09	0.39
		7	-2.44*	0.43	0.01	-4.66	-0.22			7	-2.73*	0.29	0.00	-4.19	-1.27
	5	6	-0.31	0.37	1.00	-2.43	1.82		5	6	-1.22	0.49	0.53	-3.54	1.10
		7	-1.68	0.40	0.04	-3.72	0.37			7	-2.10*	0.34	0.00	-3.88	-0.32
	6	7	-1.36*	0.23	0.00	-2.52	-0.22		6	7	-0.88	0.41	0.82	-3.14	1.38

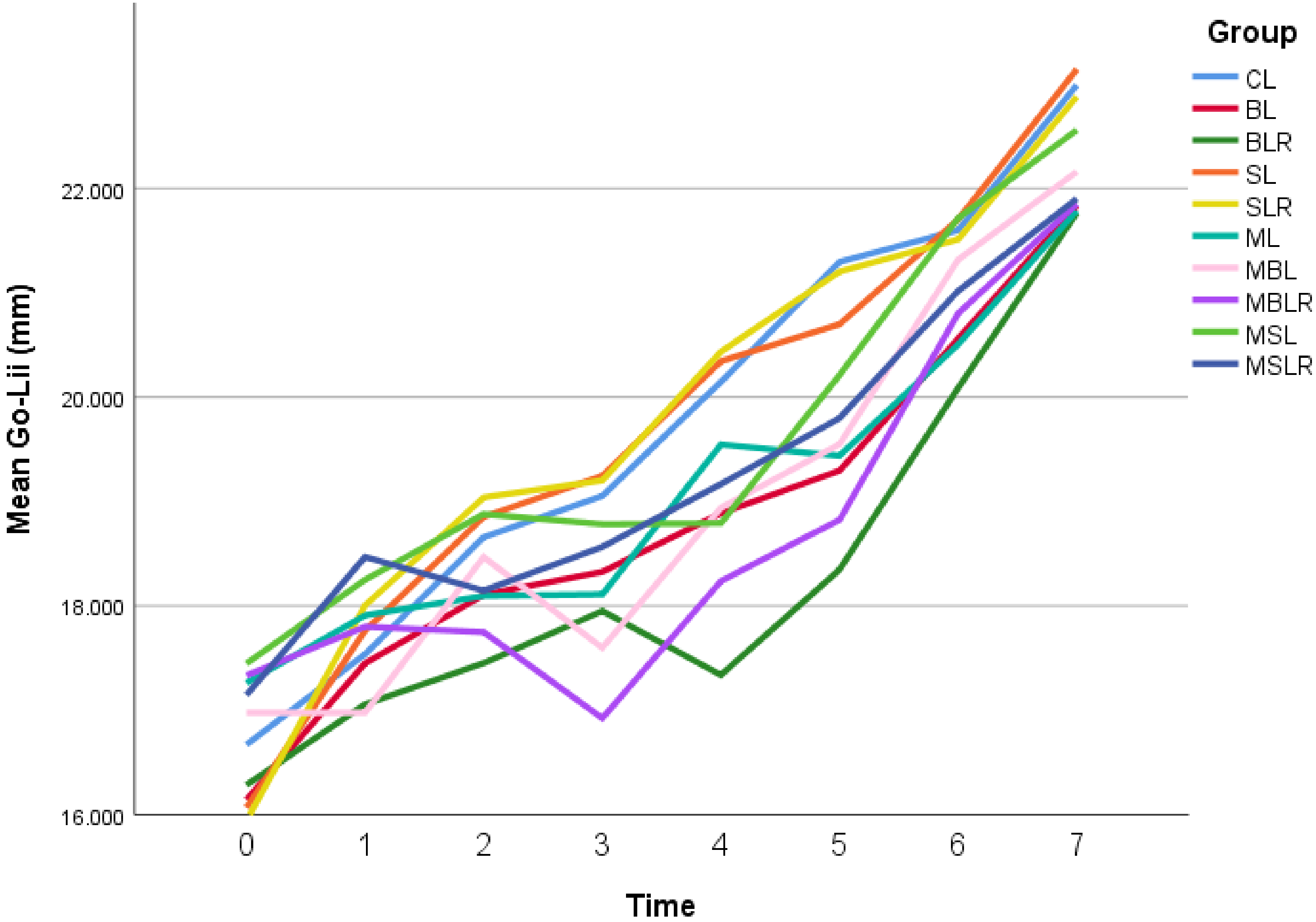


Figure 36: Line Graph of mean Go↔Lii (mm) for LC-LT Groups from T0 to T7

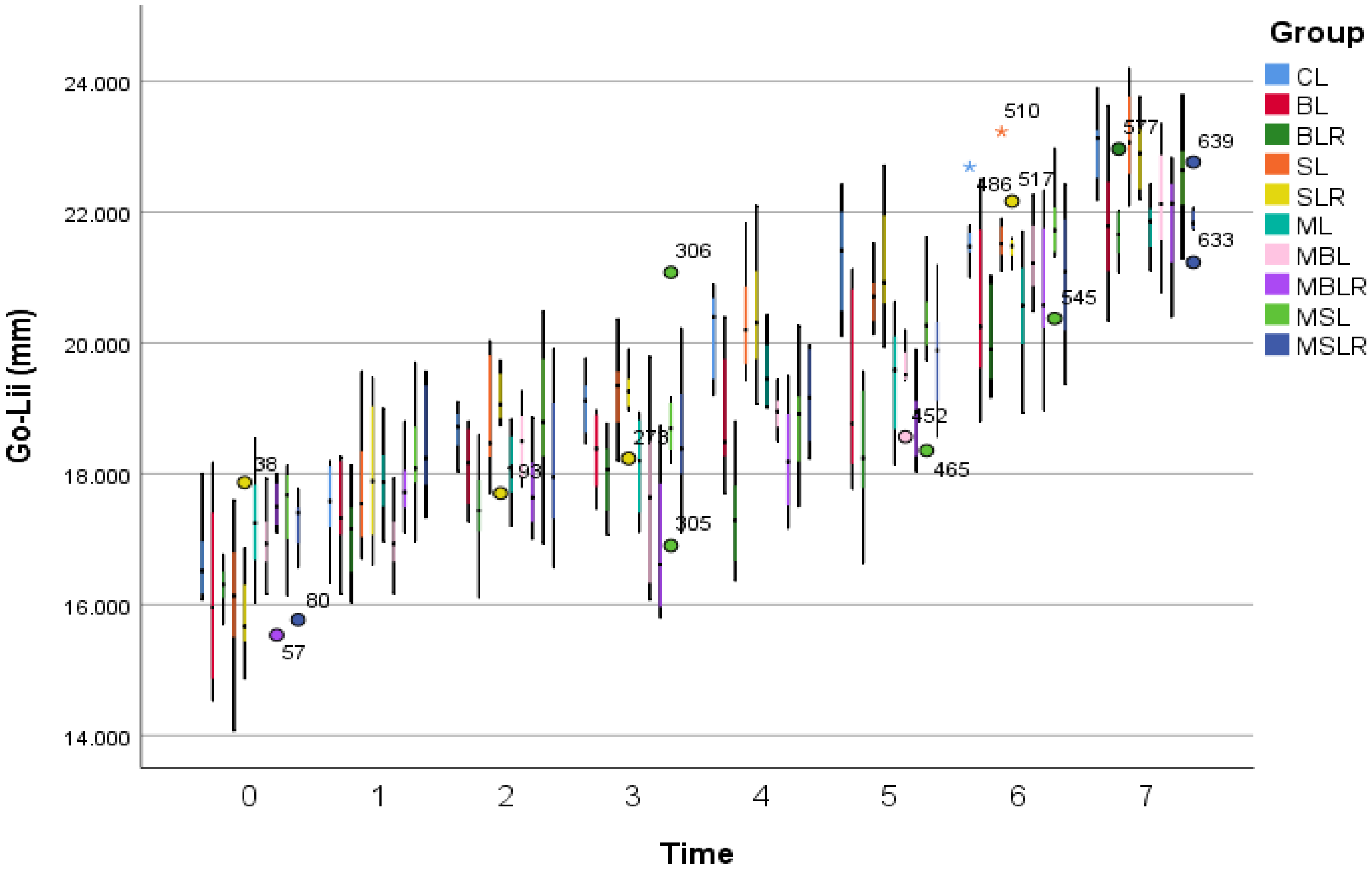


Figure 37: Boxplot of Go↔Lii (mm) for LC-LT Groups from T0 to T7

5.2.2.4 LC-LT Total Mandibular Length (Co to Dg)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Co↔Dg are displayed below (Table XXVIL). A line graph of the group means and a boxplot of Co↔Dg are displayed below in Figures 38 and 39. The MBL and MBLR group showed longer Co to Dg lengths from T1 to T4 and then at T6 and T7 although these were not statistically significantly different from the other groups.

Table XXVIL: Multiple Comparisons Within Groups LC-LT Go to Lii

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-1.03*	0.18	0.00	-1.94	-0.25	ML	0	1	-0.92	0.37	0.62	-2.91	1.08
		2	-1.90*	0.15	0.00	-2.63	-1.18			2	-0.97	0.26	0.07	-2.22	0.28
		3	-2.25*	0.26	0.00	-3.65	-0.85			3	-1.80*	0.25	0.00	-2.98	-0.63
		4	-2.98*	0.25	0.00	-4.30	-1.67			4	-1.85*	0.27	0.00	-3.14	-0.58
		5	-3.87*	0.36	0.00	-5.99	-1.75			5	-2.81*	0.19	0.00	-3.74	-1.90
		6	-4.55*	0.28	0.00	-6.07	-3.05			6	-3.52*	0.23	0.00	-4.59	-2.46
		7	-5.13*	0.22	0.00	-6.28	-3.98			7	-4.45*	0.19	0.00	-5.36	-3.55
	1	2	-0.81	0.18	0.02	-1.68	0.06		1	2	-0.05	0.40	1.00	-2.03	1.94
		3	-1.16	0.28	0.04	-2.55	0.23			3	-0.88	0.39	0.73	-2.86	1.10
		4	-1.88*	0.27	0.00	-3.20	-0.57			4	-0.94	0.40	0.67	-2.93	1.05
		5	-2.77*	0.38	0.00	-4.83	-0.72			5	-1.90	0.36	0.02	-3.93	0.14
		6	-3.46*	0.29	0.00	-4.95	-1.98			6	-2.60*	0.38	0.00	-4.59	-0.62
		7	-4.03*	0.24	0.00	-5.21	-2.86			7	-3.53*	0.36	0.00	-5.59	-1.49
	2	3	-0.35	0.27	1.00	-1.74	1.04		2	3	-0.84	0.29	0.27	-2.18	0.50
		4	-1.08	0.25	0.04	-2.39	0.23			4	-0.89	0.30	0.26	-2.30	0.52
		5	-1.97	0.37	0.02	-4.06	0.13			5	-1.85*	0.24	0.00	-3.07	-0.63
		6	-2.65*	0.28	0.00	-4.15	-1.16			6	-2.55*	0.27	0.00	-3.84	-1.28
		7	-3.22*	0.23	0.00	-4.38	-2.08			7	-3.48*	0.24	0.00	-4.71	-2.27
	3	4	-0.73	0.33	0.70	-2.26	0.80		3	4	-0.05	0.29	1.00	-1.42	1.31
		5	-1.62	0.42	0.06	-3.67	0.43			5	-1.02	0.23	0.02	-2.15	0.12
		6	-2.30*	0.35	0.00	-3.94	-0.67			6	-1.72*	0.26	0.00	-2.93	-0.51
		7	-2.88*	0.31	0.00	-4.34	-1.42			7	-2.65*	0.22	0.00	-3.79	-1.52
	4	5	-0.89	0.41	0.79	-2.93	1.15		4	5	-0.96	0.25	0.07	-2.22	0.29
		6	-1.50*	0.34	0.01	-3.17	0.02			6	-1.67*	0.27	0.00	-2.98	-0.37

		7	-2.14*	0.30	0.00	-3.55	-0.74			7	-2.60*	0.24	0.00	-3.86	-1.34
	5	6	-0.69	0.43	0.98	-2.76	1.39		5	6	-0.71	0.21	0.12	-1.71	0.29
		7	-1.26	0.40	0.23	-3.29	0.77			7	-1.63*	0.16	0.00	-2.40	-0.88
	6	7	-0.57	0.32	0.94	-2.11	0.96		6	7	-0.93	0.20	0.02	-1.92	0.06
BL	0	1	-0.84	0.37	0.71	-2.67	0.99	MBL	0	1	-1.49*	0.18	0.00	-2.31	-0.67
		2	-1.38	0.36	0.06	-3.12	0.36			2	-2.56*	0.25	0.00	-3.84	-1.30
		3	-2.31*	0.25	0.00	-3.49	-1.14			3	-2.81*	0.23	0.00	-3.93	-1.70
		4	-2.34*	0.37	0.00	-4.18	-0.51			4	-3.16*	0.22	0.00	-4.20	-2.12
		5	-3.25*	0.48	0.00	-5.83	-0.68			5	-3.56*	0.31	0.00	-5.23	-1.90
		6	-4.30*	0.42	0.00	-6.45	-2.15			6	-5.14*	0.21	0.00	-6.14	-4.15
		7	-4.82*	0.29	0.00	-6.17	-3.48			7	-5.54*	0.17	0.00	-6.36	-4.74
	1	2	-0.54	0.43	1.00	-2.56	1.48		1	2	-1.08	0.25	0.03	-2.34	0.19
		3	-1.48	0.35	0.05	-3.31	0.35			3	-1.31*	0.23	0.00	-2.43	-0.21
		4	-1.50	0.44	0.12	-3.58	0.57			4	-1.66*	0.21	0.00	-2.70	-0.63
		5	-2.42	0.54	0.02	-5.02	0.19			5	-2.07*	0.31	0.00	-3.74	-0.40
		6	-3.46*	0.49	0.00	-5.75	-1.18			6	-3.65*	0.21	0.00	-4.64	-2.66
		7	-3.98*	0.38	0.00	-5.82	-2.14			7	-4.05*	0.17	0.00	-4.85	-3.26
	2	3	-0.94	0.33	0.39	-2.66	0.79		2	3	-0.24	0.29	1.00	-1.60	1.12
		4	-0.96	0.43	0.70	-2.98	1.05			4	-0.59	0.28	0.79	-1.92	0.74
		5	-1.88	0.53	0.10	-4.46	0.71			5	-0.99	0.36	0.36	-2.70	0.71
		6	-2.92*	0.47	0.00	-5.17	-0.67			6	-2.57*	0.27	0.00	-3.88	-1.27
		7	-3.44*	0.36	0.00	-5.19	-1.69			7	-2.97*	0.25	0.00	-4.25	-1.71
	3	4	-0.03	0.35	1.00	-1.86	1.81		3	4	-0.35	0.26	1.00	-1.56	0.86
		5	-0.94	0.46	0.89	-3.57	1.70			5	-0.75	0.34	0.74	-2.42	0.91
		6	-1.98	0.40	0.02	-4.17	0.21			6	-2.33*	0.25	0.00	-3.52	-1.15
		7	-2.50*	0.26	0.00	-3.75	-1.26			7	-2.73*	0.22	0.00	-3.85	-1.63
	4	5	-0.91	0.54	0.97	-3.51	1.69		4	5	-0.40	0.33	1.00	-2.06	1.25
		6	-1.96	0.49	0.04	-4.24	0.33			6	-1.98*	0.24	0.00	-3.12	-0.85
		7	-2.47*	0.38	0.00	-4.32	-0.63			7	-2.38*	0.21	0.00	-3.42	-1.36
	5	6	-1.05	0.57	0.93	-3.75	1.66		5	6	1.58	0.33	0.01	-3.23	0.07
		7	-1.57	0.49	0.23	-4.13	1.00			7	-1.98*	0.31	0.00	-3.66	-0.31
	6	7	-0.52	0.43	1.00	-2.67	1.63		6	7	-0.41	0.20	0.87	-1.39	0.58
BLR	0	1	-0.78	0.27	0.28	-2.05	0.49	MBLR	0	1	-1.94*	0.29	0.00	-3.33	-0.56
		2	-1.35	0.32	0.04	-2.96	0.25			2	-2.11*	0.22	0.00	-3.18	-1.05
		3	-1.72*	0.25	0.00	-2.89	-0.57			3	-3.09*	0.23	0.00	-4.17	-2.03
		4	-1.88*	0.30	0.00	-3.34	-0.42			4	-3.11*	0.29	0.00	-4.51	-1.72

		5	-2.60*	0.33	0.00	-4.29	-0.92			5	-3.90*	0.29	0.00	-5.31	-2.50
		6	-3.95*	0.32	0.00	-5.59	-2.31			6	-5.05*	0.21	0.00	-6.09	-4.02
		7	-4.88*	0.26	0.00	-6.14	-3.64			7	-5.64*	0.26	0.00	-6.88	-4.41
	1	2	-0.58	0.35	0.97	-2.23	1.08		1	2	-0.17	0.27	1.00	-1.52	1.18
		3	-0.95	0.28	0.13	-2.28	0.38			3	-1.15	0.27	0.03	-2.50	0.20
		4	-1.10	0.33	0.13	-2.64	0.44			4	-1.17	0.33	0.08	-2.70	0.36
		5	-1.82*	0.36	0.01	-3.55	-0.10			5	-1.96*	0.33	0.00	-3.51	-0.42
		6	-3.17*	0.35	0.00	-4.86	-1.48			6	-3.11*	0.26	0.00	-4.46	-1.76
		7	-4.10*	0.30	0.00	-5.49	-2.72			7	-3.70*	0.30	0.00	-5.13	-2.27
	2	3	-0.38	0.33	1.00	-2.00	1.25		2	3	-0.98*	0.20	0.01	-1.91	-0.06
		4	-0.53	0.37	1.00	-2.27	1.22			4	-1.00	0.27	0.09	-2.35	0.35
		5	-1.25	0.40	0.19	-3.12	0.62			5	-1.79*	0.27	0.00	-3.16	-0.42
		6	-2.59*	0.39	0.00	-4.44	-0.75			6	-2.94*	0.18	0.00	-3.81	-2.08
		7	-3.53*	0.35	0.00	-5.18	-1.88			7	-3.53*	0.24	0.00	-4.69	-2.37
	3	4	-0.15	0.31	1.00	-1.64	1.34		3	4	-0.02	0.27	1.00	-1.37	1.34
		5	-0.87	0.35	0.54	-2.57	0.83			5	-0.81	0.27	0.31	-2.18	0.56
		6	-2.22*	0.34	0.00	-3.88	-0.57			6	-1.96*	0.19	0.00	-2.83	-1.09
		7	-3.15*	0.28	0.00	-4.47	-1.84			7	-2.54*	0.24	0.00	-3.72	-1.38
	4	5	-0.72	0.38	0.91	-2.52	1.08		4	5	-0.79	0.33	0.59	-2.34	0.76
		6	-2.06*	0.38	0.00	-3.84	-0.30			6	-1.94*	0.26	0.00	-3.29	-0.59
		7	-3.00*	0.32	0.00	-4.54	-1.48			7	-2.53*	0.30	0.00	-3.96	-1.10
	5	6	-1.35	0.40	0.13	-3.24	0.54		5	6	-1.15	0.26	0.04	-2.52	0.22
		7	-2.28*	0.36	0.00	-4.01	-0.57			7	-1.74*	0.31	0.00	-3.19	-0.29
	6	7	-0.94	0.35	0.42	-2.62	0.74		6	7	-0.59	0.23	0.52	-1.73	0.56
SL	0	1	-1.71	0.46	0.07	-3.88	0.46	MSL	0	1	-0.72	0.37	0.88	-2.47	1.02
		2	-2.62*	0.40	0.00	-4.48	-0.78			2	-1.01	0.42	0.60	-3.02	1.00
		3	-2.99*	0.34	0.00	-4.68	-1.31			3	-1.95*	0.30	0.00	-3.51	-0.40
		4	-3.54*	0.39	0.00	-5.36	-1.73			4	-2.10*	0.39	0.00	-3.95	-0.26
		5	-4.38*	0.35	0.00	-6.08	-2.68			5	-3.52*	0.33	0.00	-5.11	-1.94
		6	-5.32*	0.33	0.00	-7.01	-3.65			6	-3.82*	0.34	0.00	-5.42	-2.22
		7	-5.49*	0.37	0.00	-7.25	-3.73			7	-4.38*	0.34	0.00	-6.01	-2.77
	1	2	-0.92	0.45	0.82	-3.06	1.21		1	2	-0.29	0.42	1.00	-2.29	1.70
		3	-1.29	0.40	0.21	-3.36	0.79			3	-1.23	0.29	0.05	-2.75	0.29
		4	-1.84	0.44	0.03	-3.96	0.27			4	-1.38	0.39	0.09	-3.22	0.45
		5	-2.67*	0.41	0.00	-4.75	-0.61			5	-2.80*	0.33	0.00	-4.36	-1.25
		6	-3.61*	0.39	0.00	-5.71	-1.53			6	-3.10*	0.33	0.00	-4.68	-1.53

		7	-3.78*	0.43	0.00	-5.87	-1.70			7	-3.66*	0.34	0.00	-5.26	-2.07
	2	3	-0.37	0.32	1.00	-1.95	1.22		2	3	-0.94	0.36	0.53	-2.89	1.01
		4	-0.92	0.37	0.54	-2.66	0.83			4	-1.09	0.44	0.53	-3.16	0.97
		5	-1.75*	0.33	0.01	-3.36	-0.15			5	-2.51*	0.38	0.00	-4.43	-0.59
		6	-2.69*	0.31	0.00	-4.27	-1.12			6	-2.81*	0.39	0.00	-4.73	-0.89
		7	-2.86*	0.36	0.00	-4.54	-1.18			7	-3.37*	0.39	0.00	-5.30	-1.44
	3	4	-0.55	0.31	0.95	-2.07	0.96		3	4	-0.15	0.32	1.00	-1.85	1.55
		5	-1.38*	0.26	0.00	-2.62	-0.15			5	-1.57*	0.24	0.00	-2.72	-0.43
		6	-2.33*	0.24	0.00	-3.45	-1.21			6	-1.87*	0.24	0.00	-3.06	-0.68
		7	-2.49*	0.29	0.00	-3.90	-1.10			7	-2.43*	0.25	0.00	-3.68	-1.19
	4	5	-0.84	0.32	0.47	-2.38	0.71		4	5	-1.42	0.35	0.04	-3.13	0.28
		6	-1.77*	0.30	0.00	-3.28	-0.28			6	-1.71*	0.35	0.01	-3.43	0.00
		7	-1.94*	0.35	0.00	-3.57	-0.32			7	-2.27*	0.36	0.00	-4.01	-0.55
	5	6	-0.94	0.25	0.07	-2.14	0.25		5	6	-0.30	0.28	1.00	-1.61	1.02
		7	-1.11	0.30	0.08	-2.54	0.33			7	-0.86	0.29	0.25	-2.21	0.49
	6	7	-0.17	0.28	1.00	-1.54	1.21		6	7	-0.56	0.29	0.90	-1.94	0.82
SLR	0	1	-1.39	0.46	0.22	-3.54	0.75	MSLR	0	1	-0.84	0.29	0.31	-2.26	0.57
		2	-2.65*	0.42	0.00	-4.67	-0.64			2	-0.88	0.44	0.87	-3.07	1.30
		3	-3.07*	0.37	0.00	-5.09	-1.05			3	-1.69*	0.28	0.00	-3.09	-0.31
		4	-3.33*	0.39	0.00	-5.32	-1.35			4	-1.85*	0.37	0.01	-3.61	-0.09
		5	-4.30*	0.39	0.00	-6.29	-2.32			5	-2.86*	0.33	0.00	-4.42	-1.30
		6	-4.95*	0.39	0.00	-6.93	-2.97			6	-3.82*	0.42	0.00	-5.84	-1.81
		7	-5.12*	0.40	0.00	-7.11	-3.14			7	-4.30*	0.28	0.00	-5.70	-2.91
	1	2	-1.26	0.39	0.16	-3.11	0.59		1	2	-0.04	0.41	1.00	-2.23	2.15
		3	-1.68	0.33	0.02	-3.47	0.11			3	-0.86	0.22	0.05	-1.89	0.18
		4	-1.94*	0.36	0.01	-3.73	-0.16			4	-1.01	0.33	0.27	-2.68	0.66
		5	-2.90*	0.36	0.00	-4.69	-1.12			5	-2.02*	0.29	0.00	-3.41	-0.64
		6	-3.55*	0.35	0.00	-5.33	-1.78			6	-2.98*	0.38	0.00	-4.97	-0.99
		7	-3.73*	0.37	0.00	-5.53	-1.93			7	-3.46*	0.22	0.00	-4.52	-2.41
	2	3	-0.42	0.28	0.99	-1.82	0.98		2	3	-0.82	0.40	0.87	-3.04	1.41
		4	-0.68	0.31	0.74	-2.15	0.79			4	-0.97	0.47	0.82	-3.22	1.28
		5	-1.64*	0.31	0.00	-3.11	-0.18			5	-1.98	0.44	0.02	-4.16	0.20
		6	-2.29*	0.30	0.00	-3.74	-0.85			6	-2.94*	0.51	0.00	-5.31	-0.57
		7	-2.47*	0.32	0.00	-3.97	-0.97			7	-3.42*	0.40	0.00	-5.64	-1.21
	3	4	-0.26	0.24	1.00	-1.42	0.89		3	4	-0.15	0.32	1.00	-1.83	1.53
		5	-1.22*	0.24	0.01	-2.37	-0.09			5	-1.17	0.27	0.03	-2.52	0.19

		6	-1.87*	0.22	0.00	-2.95	-0.80			6	-2.12*	0.37	0.01	-4.14	-0.11
		7	-2.05*	0.25	0.00	-3.27	-0.83			7	-2.60*	0.20	0.00	-3.55	-1.67
	4	5	-0.97	0.28	0.09	-2.25	0.32		4	5	-1.01	0.37	0.37	-2.76	0.74
		6	-1.61*	0.27	0.00	-2.86	-0.36			6	-1.97	0.45	0.02	-4.07	0.13
		7	-1.78*	0.29	0.00	-3.13	-0.45			7	-2.45*	0.32	0.00	-4.13	-0.78
	5	6	-0.65	0.26	0.55	-1.88	0.59		5	6	-0.96	0.41	0.66	-2.97	1.05
		7	-0.82	0.28	0.28	-2.15	0.51			7	-1.44*	0.28	0.01	-2.80	-0.08
	6	7	-0.18	0.28	1.00	-1.47	1.12		6	7	-0.48	0.37	1.00	-2.49	1.52

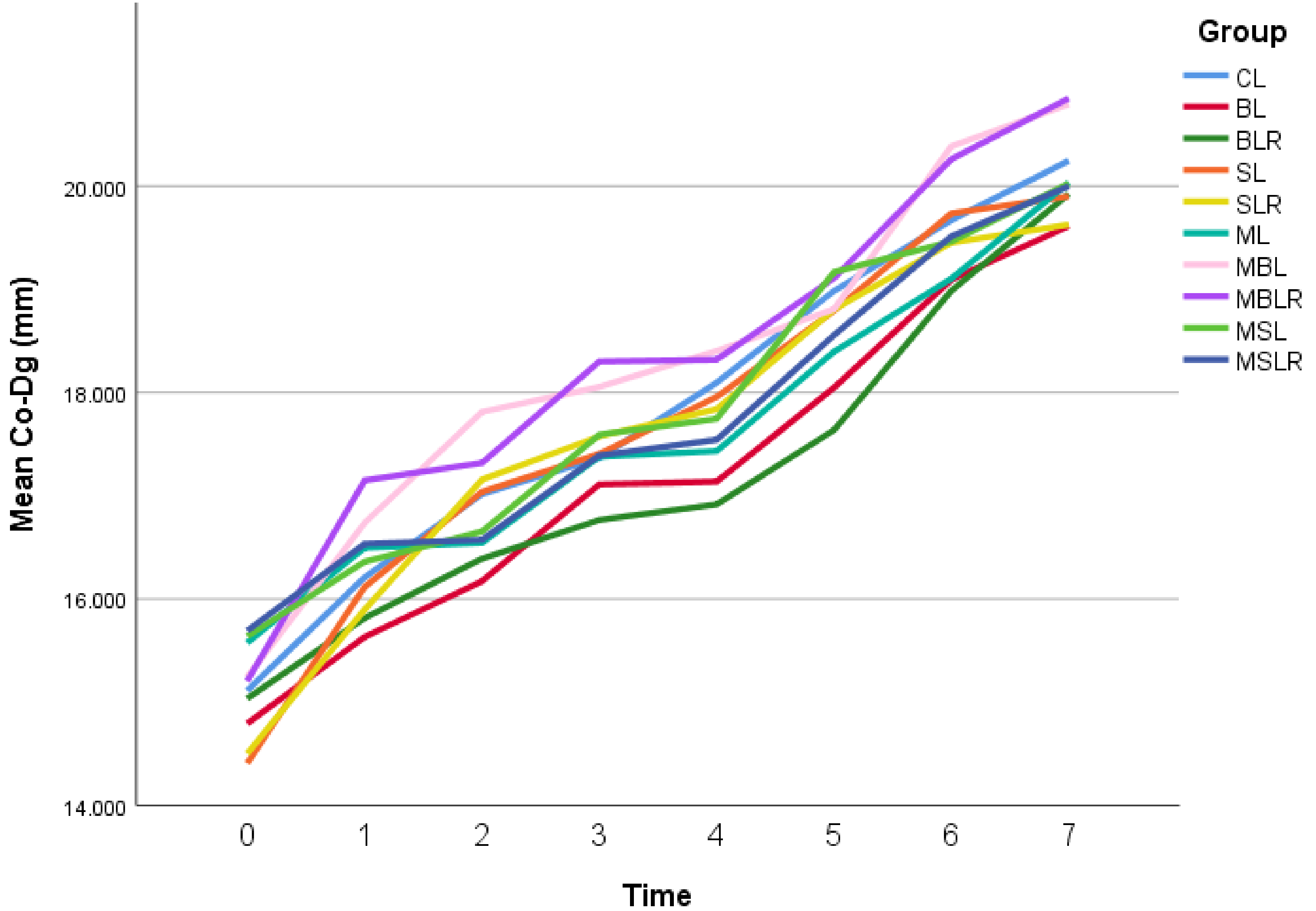


Figure 38: Line Graph of Mean Co↔Dg (mm) LC-LT groups from To to T7

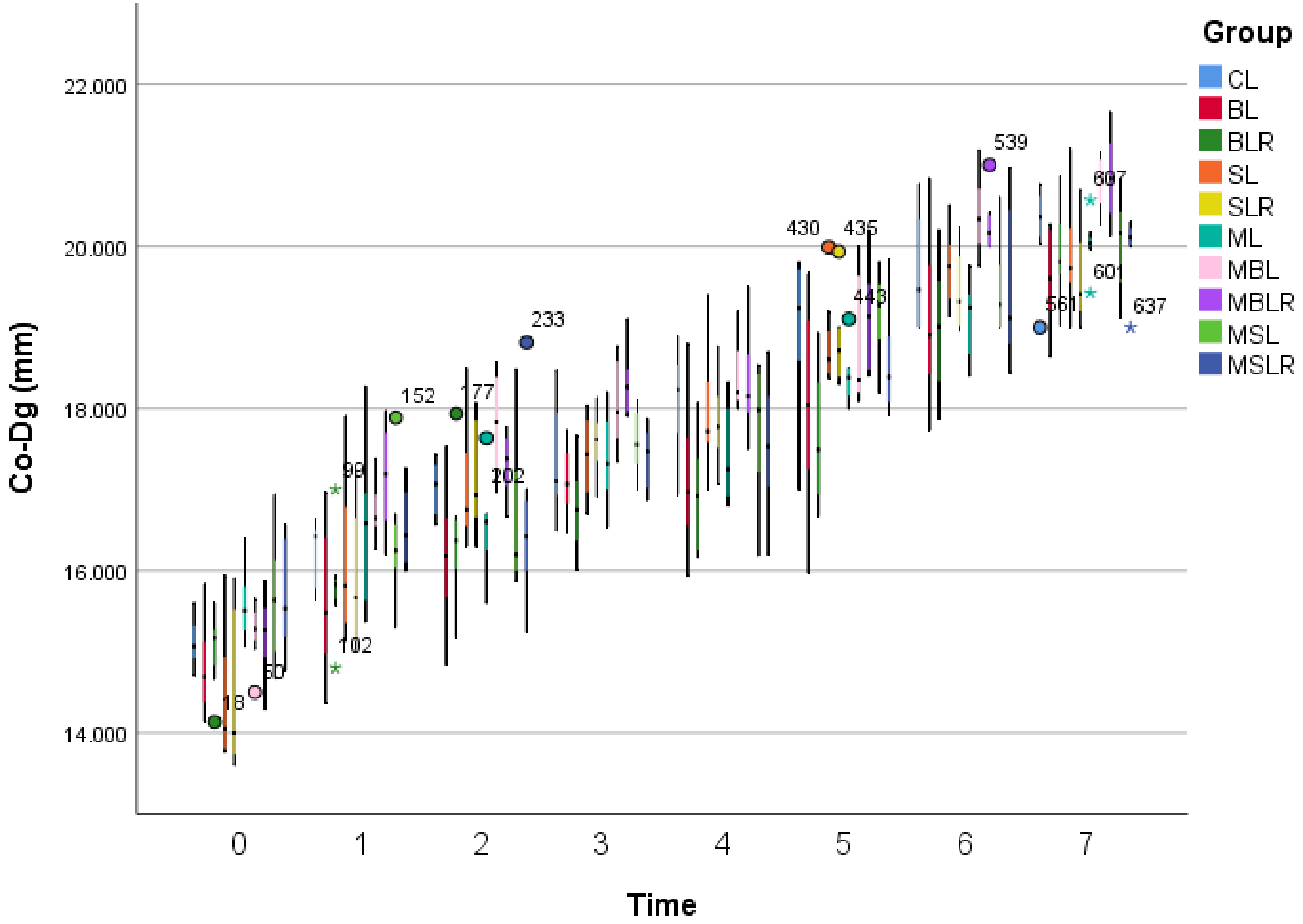


Figure 39: Boxplot of Co↔Dg (mm) LC-LT groups from T0 to T7

5.2.2.5 Postured Mandibular Length (Ar to Dg)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Ar↔Dg are displayed below (Table XXVII). A line graph of the group means and a boxplot of Ar↔Dg are displayed below in Figures 40 and 41. At T2 the BLR group had a shorter Ar↔Dg length than the MBLR group ($p \le 0.01$). At T3 the BLR group had a significantly shorter Ar↔Dg length than the CL, SL, SLR, MBL, and MBLR groups ($p \le 0.01$). At T4 the BLR group had a significantly shorter Ar↔Dg length than the MBL, MBLR, MSL, and MSLR groups ($p \le 0.01$). At T5 the BLR group had a significantly shorter Ar↔Dg length than the MBL group ($p \le 0.01$). At T7 the BLR group had a significantly shorter Ar↔Dg length than the MBL and MBLR groups ($p \le 0.01$).

Table XXVII: Within Groups Multiple Comparisons LC-LT for Ar to Dg

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \le 0.01$ or $p \le 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.60	0.28	0.79	-1.96	0.76	ML	0	1	-1.00	0.40	0.50	-2.87	0.86
		2	-1.42*	0.27	0.00	-2.72	-0.13			2	-2.06	0.47	0.02	-4.34	0.22
		3	-2.23*	0.24	0.00	-3.35	-1.12			3	-2.12*	0.39	0.00	-4.16	-0.48
		4	-2.32*	0.27	0.00	-3.61	-1.05			4	-2.43*	0.28	0.00	-4.05	-0.82
		5	-3.18*	0.30	0.00	-4.65	-1.73			5	-2.69*	0.31	0.00	-4.26	-1.13
		6	-3.64*	0.20	0.00	-4.63	-2.65			6	-3.30*	0.34	0.00	-4.92	-1.70
		7	-4.91*	0.24	0.00	-6.04	-3.79			7	-4.52*	0.30	0.00	-6.08	-2.96
	1	2	-0.82	0.31	0.44	-2.28	0.64		1	2	-1.05	0.49	0.76	-3.37	1.26
		3	-1.63*	0.28	0.00	-2.98	-0.28			3	-1.32	0.41	0.17	-3.24	0.61
		4	-1.72*	0.31	0.00	-3.18	-0.27			4	-1.43	0.31	0.04	-3.21	0.36
		5	-2.58*	0.34	0.00	-4.16	-1.01			5	-1.69*	0.34	0.01	-3.40	0.02
		6	-3.03*	0.25	0.00	-4.37	-1.70			6	-2.30*	0.36	0.00	-4.04	-0.57
		7	-4.30*	0.28	0.00	-5.67	-2.95			7	-3.57*	0.32	0.00	-5.24	-1.79
	2	3	-0.81	0.27	0.24	-2.10	0.47		2	3	-0.26	0.48	1.00	-2.57	2.05
		4	-0.91	0.30	0.22	-2.31	0.49			4	-0.37	0.40	1.00	-2.77	2.02
		5	-1.76*	0.33	0.00	-3.30	-0.23			5	-0.63	0.42	0.99	-2.91	1.64
		6	-2.21*	0.24	0.00	-3.47	-0.97			6	-1.25	0.44	0.37	-3.50	1.00
		7	-3.49*	0.27	0.00	-4.79	-2.20			7	-2.46*	0.41	0.01	-4.78	-0.14
	3	4	-0.09	0.27	1.00	-1.37	1.18		3	4	-0.11	0.30	1.00	-1.85	1.63
		5	-0.95	0.30	0.19	-2.40	0.50			5	-0.37	0.33	1.00	-2.04	1.30
		6	-1.40*	0.19	0.00	-2.37	-0.44			6	-0.99	0.35	0.36	-2.69	0.72

		7	-2.67*	0.24	0.00	-3.79	-1.57			7	-2.10*	0.32	0.00	-3.88	-0.51
	4	5	-0.86	0.32	0.43	-2.39	0.67		4	5	-0.26	0.18	1.00	-1.21	0.69
		6	-1.31*	0.23	0.01	-2.54	-0.08			6	-0.88	0.22	0.09	-2.09	0.34
		7	-2.58*	0.27	0.00	-3.87	-1.30			7	-2.08*	0.16	0.00	-2.86	-1.32
	5	6	-0.45	0.27	0.97	-1.92	1.01		5	6	-0.62	0.26	0.64	-1.87	0.63
		7	-1.72*	0.30	0.00	-3.18	-0.27			7	-1.82*	0.21	0.00	-2.82	-0.84
	6	7	-1.27*	0.20	0.00	-2.27	-0.28		6	7	-1.21*	0.24	0.01	-2.42	0.00
BL	0	1	-0.84	0.38	0.75	-2.70	1.02	MBL	0	1	-0.38	0.26	1.00	-1.92	1.17
		2	-1.37	0.39	0.11	-3.25	0.51			2	-1.83	0.43	0.03	-3.92	0.26
		3	-1.84*	0.40	0.01	-3.74	0.05			3	-1.80*	0.30	0.00	-3.27	-0.34
		4	-2.26*	0.43	0.00	-4.26	-0.26			4	-2.6*	0.28	0.00	-4.15	-1.24
		5	-2.57*	0.44	0.00	-4.98	-0.90			5	-3.02*	0.30	0.00	-4.49	-1.56
		6	-3.62*	0.43	0.00	-5.66	-1.59			6	-3.88*	0.36	0.00	-5.56	-2.21
		7	-4.86*	0.43	0.00	-6.88	-2.86			7	-4.63*	0.30	0.00	-6.09	-3.18
	1	2	-0.53	0.31	0.96	-1.98	0.92		1	2	-1.46	0.36	0.11	-3.68	0.77
		3	-1.01	0.32	0.18	-2.50	0.49			3	-1.43*	0.18	0.00	-2.46	-0.41
		4	-1.43	0.35	0.04	-3.13	0.27			4	-2.32*	0.13	0.00	-3.03	-1.61
		5	-2.10*	0.37	0.00	-3.88	-0.34			5	-2.65*	0.18	0.00	-3.65	-1.65
		6	-2.78*	0.36	0.00	-4.54	-1.04			6	-3.51*	0.26	0.00	-5.10	-1.92
		7	-4.03*	0.36	0.00	-5.75	-2.32			7	-4.25*	0.17	0.00	-5.22	-3.30
	2	3	-0.48	0.33	1.00	-2.02	1.07		2	3	0.02	0.39	1.00	-2.04	2.08
		4	-0.89	0.37	0.56	-2.63	0.84			4	-0.86	0.37	0.74	-2.98	1.25
		5	-1.58	0.38	0.03	-3.37	0.22			5	-1.19	0.39	0.29	-3.26	0.87
		6	-2.25*	0.37	0.00	-4.04	-0.48			6	-2.05*	0.44	0.01	-4.15	0.05
		7	-3.50*	0.37	0.00	-5.25	-1.76			7	-2.80*	0.39	0.00	-4.87	-0.73
	3	4	-0.42	0.37	1.00	-2.17	1.34		3	4	-0.89	0.21	0.03	-1.89	0.12
		5	-1.10	0.38	0.31	-2.92	0.72			5	-1.21*	0.24	0.01	-2.33	-0.10
		6	-1.78*	0.38	0.01	-3.59	0.02			6	-2.07*	0.31	0.00	-3.58	-0.57
		7	-3.02*	0.38	0.00	-4.80	-1.25			7	-2.82*	0.23	0.00	-3.92	-1.73
	4	5	-0.68	0.41	0.97	-2.62	1.25		4	5	-0.33	0.21	0.98	-1.32	0.66
		6	-1.36	0.41	0.13	-3.29	0.56			6	-1.19	0.28	0.05	-2.69	0.31
		7	-2.60*	0.41	0.00	-4.50	-0.71			7	-1.93*	0.20	0.00	-2.90	-0.98
	5	6	-0.68	0.42	0.98	-2.65	1.29		5	6	-0.86	0.31	0.36	-2.36	0.64
		7	-1.93*	0.42	0.01	-3.87	0.02			7	-1.60	0.23	0.00	-2.69	-0.53
	6	7	-1.24	0.41	0.23	-3.18	0.69		6	7	-0.75	0.30	0.57	-2.25	0.75
BLR	0	1	-0.69	0.20	0.09	-1.61	0.22	MBLR	0	1	-0.98	0.24	0.05	-2.19	0.23

		2	-1.29*	0.20	0.00	-2.25	-0.34			2	-1.69*	0.36	0.01	-3.43	0.04
		3	-1.29*	0.20	0.00	-2.25	-0.34			3	-2.51*	0.31	0.00	-3.96	-1.07
		4	-1.61*	0.26	0.00	-2.87	-0.36			4	-2.96*	0.34	0.00	-4.61	-1.32
		5	-2.50*	0.27	0.00	-3.84	-1.17			5	-3.12*	0.28	0.00	-4.45	-1.79
		6	-3.42*	0.27	0.00	-4.78	-2.07			6	-4.15*	0.31	0.00	-5.60	-2.71
		7	-4.27*	0.25	0.00	-5.45	-3.10			7	-5.189	0.27	0.00	-6.47	-3.91
	1	2	-0.60	0.20	0.20	-1.52	0.31		1	2	-0.71	0.32	0.76	-2.44	1.01
		3	-0.60	0.20	0.20	-1.52	0.31			3	-1.53*	0.26	0.00	-2.86	-0.21
		4	-0.92	0.25	0.09	-2.17	0.33			4	-1.98*	0.30	0.00	-3.59	-0.37
		5	-1.81	0.26	0.00	-3.14	-0.48			5	-2.14*	0.23	0.00	-3.28	-1.00
		6	-2.73*	0.27	0.00	-4.09	-1.38			6	-3.17*	0.26	0.00	-4.50	-1.85
		7	-3.58	0.24	0.00	-4.74	-2.42			7	-4.21*	0.22	0.00	-5.25	-3.18
	2	3	0.00	0.20	1.00	-0.95	0.95		2	3	-0.82	0.37	0.72	-2.59	0.94
		4	-0.32	0.26	1.00	-1.58	0.94			4	-1.27	0.40	0.18	-3.15	0.61
		5	-1.21	0.27	0.02	-2.54	0.13			5	-1.43	0.35	0.04	-3.15	0.29
		6	-2.12*	0.27	0.00	-3.48	-0.77			6	-2.46*	0.37	0.00	-4.23	-0.70
		7	-2.97*	0.25	0.00	-4.15	-1.80			7	-3.49*	0.34	0.00	-5.20	-1.79
	3	4	-0.32	0.26	1.00	-1.58	0.94		3	4	-0.45	0.36	1.00	-2.13	1.24
		5	-1.21	0.27	0.02	-2.54	0.13			5	-0.61	0.30	0.84	-2.02	0.81
		6	-2.12*	0.27	0.00	-3.48	-0.77			6	-1.63*	0.32	0.01	-3.14	-0.13
		7	-2.97*	0.25	0.00	-4.15	-1.80			7	-2.67*	0.29	0.00	-4.04	-1.30
	4	5	-0.89	0.31	0.31	-2.35	0.57		4	5	-0.16	0.34	1.00	-1.79	1.47
		6	-1.81*	0.32	0.00	-3.29	-0.33			6	-1.19	0.36	0.13	-2.88	0.49
		7	-2.65*	0.29	0.00	-4.02	-1.29			7	-2.22*	0.33	0.00	-3.83	-0.62
	5	6	-0.92	0.33	0.31	-2.44	0.60		5	6	-1.03	0.30	0.11	-2.44	0.38
		7	-1.76*	0.30	0.00	-3.19	-0.35			7	-2.06*	0.26	0.00	-3.29	-0.84
	6	7	-0.85	0.31	0.35	-2.29	0.59		6	7	-1.04	0.29	0.08	-2.40	0.33
SL	0	1	-1.06	0.35	0.22	-2.68	0.57	MSL	0	1	-0.94	0.38	0.53	-2.70	0.83
		2	-2.08*	0.39	0.00	-3.94	-0.23			2	-1.13	0.31	0.08	-2.61	0.36
		3	-2.61*	0.26	0.00	-4.04	-1.19			3	-1.72*	0.35	0.01	-3.37	-0.09
		4	-3.04*	0.33	0.00	-4.59	-1.50			4	-2.53*	0.29	0.00	-3.99	-1.08
		5	-3.62*	0.30	0.00	-5.04	-2.20			5	-2.64*	0.36	0.00	-4.30	-0.98
		6	-4.64*	0.28	0.00	-6.04	-3.26			6	-3.43*	0.30	0.00	-4.90	-1.97
		7	-5.37*	0.32	0.00	-6.88	-3.87			7	-4.47*	0.33	0.00	-6.04	-2.91
	1	2	-1.03	0.40	0.46	-2.91	0.85		1	2	-0.19	0.34	1.00	-1.84	1.46
		3	-1.55*	0.27	0.01	-3.06	-0.06			3	-0.79	0.37	0.78	-2.55	0.96

		4	-1.98*	0.34	0.00	-3.58	-0.40			4	-1.60*	0.32	0.01	-3.24	0.04
		5	-2.56*	0.31	0.00	-4.05	-1.08			5	-1.71*	0.38	0.01	-3.48	0.07
		6	-3.59*	0.29	0.00	-5.06	-2.13			6	-2.50*	0.32	0.00	-4.14	-0.86
		7	-4.32*	0.33	0.00	-5.88	-2.77			7	-3.53*	0.36	0.00	-5.24	-1.84
	2	3	-0.53	0.32	0.99	-2.40	1.34		2	3	-0.60	0.31	0.87	-2.07	0.86
		4	-0.96	0.38	0.53	-2.79	0.88			4	-1.41*	0.24	0.00	-2.53	-0.30
		5	-1.54	0.35	0.03	-3.33	0.26			5	-1.51*	0.31	0.01	-3.02	-0.01
		6	-2.56*	0.34	0.00	-4.37	-0.76			6	-2.31*	0.24	0.00	-3.46	-1.16
		7	-3.29*	0.37	0.00	-5.11	-1.47			7	-3.34*	0.29	0.00	-4.70	-1.99
	3	4	-0.43	0.24	0.97	-1.77	0.91		3	4	-0.81	0.29	0.37	-2.24	0.62
		5	-1.00*	0.20	0.01	-2.01	0.00			5	-0.91	0.35	0.46	-2.56	0.74
		6	-2.03*	0.17	0.00	-2.86	-1.21			6	-1.70*	0.29	0.00	-3.15	-0.27
		7	-2.76*	0.23	0.00	-4.02	-1.51			7	-2.74*	0.33	0.00	-4.29	-1.19
	4	5	-0.58	0.29	0.84	-1.94	0.78		4	5	-0.10	0.29	1.00	-1.58	1.37
		6	-1.60*	0.27	0.00	-2.93	-0.28			6	-0.90	0.22	0.03	-1.93	0.13
		7	-2.33*	0.31	0.00	-3.79	-0.88			7	-1.93*	0.27	0.00	-3.23	-0.64
	5	6	-1.03*	0.22	0.01	-2.08	0.03		5	6	-0.80	0.30	0.46	-2.28	0.69
		7	-1.75*	0.27	0.00	-3.05	-0.46			7	-1.83*	0.34	0.00	-3.41	-0.25
	6	7	-0.73	0.26	0.34	-1.98	0.52		6	7	-1.04	0.27	0.06	-2.35	0.28
SLR	0	1	-0.89	0.43	0.85	-3.15	1.36	MSLR	0	1	-1.32	0.38	0.11	-3.11	0.48
		2	-1.97	0.48	0.04	-4.27	0.33			2	-1.49	0.36	0.03	-3.17	0.20
		3	-2.48*	0.41	0.01	-4.79	-0.18			3	-1.75*	0.32	0.00	-3.25	-0.26
		4	-2.91*	0.44	0.00	-5.16	-0.66			4	-2.59*	0.30	0.00	-4.04	-1.15
		5	-3.51*	0.43	0.00	-5.77	-1.26			5	-2.64*	0.34	0.00	-4.25	-1.05
		6	-4.17*	0.40	0.00	-6.56	-1.79			6	-3.52*	0.39	0.00	-5.36	-1.70
		7	-5.44*	0.45	0.00	-7.70	-3.20			7	-4.26*	0.36	0.00	-5.96	-2.57
	1	2	-1.08	0.35	0.22	-2.75	0.60		1	2	-0.17	0.39	1.00	-2.01	1.67
		3	-1.59*	0.24	0.00	-2.77	-0.41			3	-0.44	0.35	1.00	-2.15	1.28
		4	-2.01*	0.29	0.00	-3.39	-0.64			4	-1.27	0.34	0.08	-2.97	0.42
		5	-2.62*	0.28	0.00	-3.92	-1.33			5	-1.33	0.38	0.09	-3.11	0.45
		6	-3.28*	0.22	0.00	-4.44	-2.12			6	-2.21*	0.42	0.00	-4.17	-0.26
		7	-4.55*	0.30	0.00	-5.96	-3.15			7	-2.94*	0.39	0.00	-4.80	-1.10
	2	3	-0.51	0.32	0.98	-2.17	1.14		2	3	-0.27	0.33	1.00	-1.85	1.31
		4	-0.94	0.36	0.44	-2.64	0.76			4	-1.11	0.31	0.11	-2.65	0.44
		5	-1.55	0.34	0.02	-3.22	0.12			5	-1.16	0.36	0.15	-2.83	0.51
		6	-2.20*	0.30	0.00	-3.92	-0.50			6	-2.04*	0.40	0.01	-3.92	-0.17

		7	-3.47*	0.36	0.00	-5.20	-1.76			7	-2.78*	0.37	0.00	-4.53	-1.03
	3	4	-0.43	0.26	0.98	-1.69	0.84		3	4	-0.83	0.26	0.17	-2.06	0.39
		5	-1.03	0.24	0.02	-2.18	0.12			5	-0.89	0.31	0.30	-2.35	0.58
		6	-1.69*	0.17	0.00	-2.53	-0.86			6	-1.77*	0.36	0.01	-3.53	-0.01
		7	-2.96*	0.27	0.00	-4.28	-1.65			7	-2.50*	0.33	0.00	-4.10	-0.92
	4	5	-0.61	0.29	0.80	-1.96	0.75		4	5	-0.06	0.29	1.00	-1.46	1.35
		6	-1.27*	0.23	0.01	-2.54	0.01			6	-0.94	0.34	0.43	-2.68	0.81
		7	-2.53*	0.31	0.00	-4.00	-1.08			7	-1.67*	0.31	0.01	-3.23	-0.12
	5	6	-0.66	0.21	0.28	-1.79	0.47		5	6	-0.88	0.38	0.66	-2.70	0.93
		7	-1.93*	0.30	0.00	-3.33	-0.54			7	-1.62*	0.36	0.01	-3.29	0.05
	6	7	-1.27*	0.24	0.01	-2.60	0.05		6	7	-0.74	0.40	0.92	-2.62	1.14

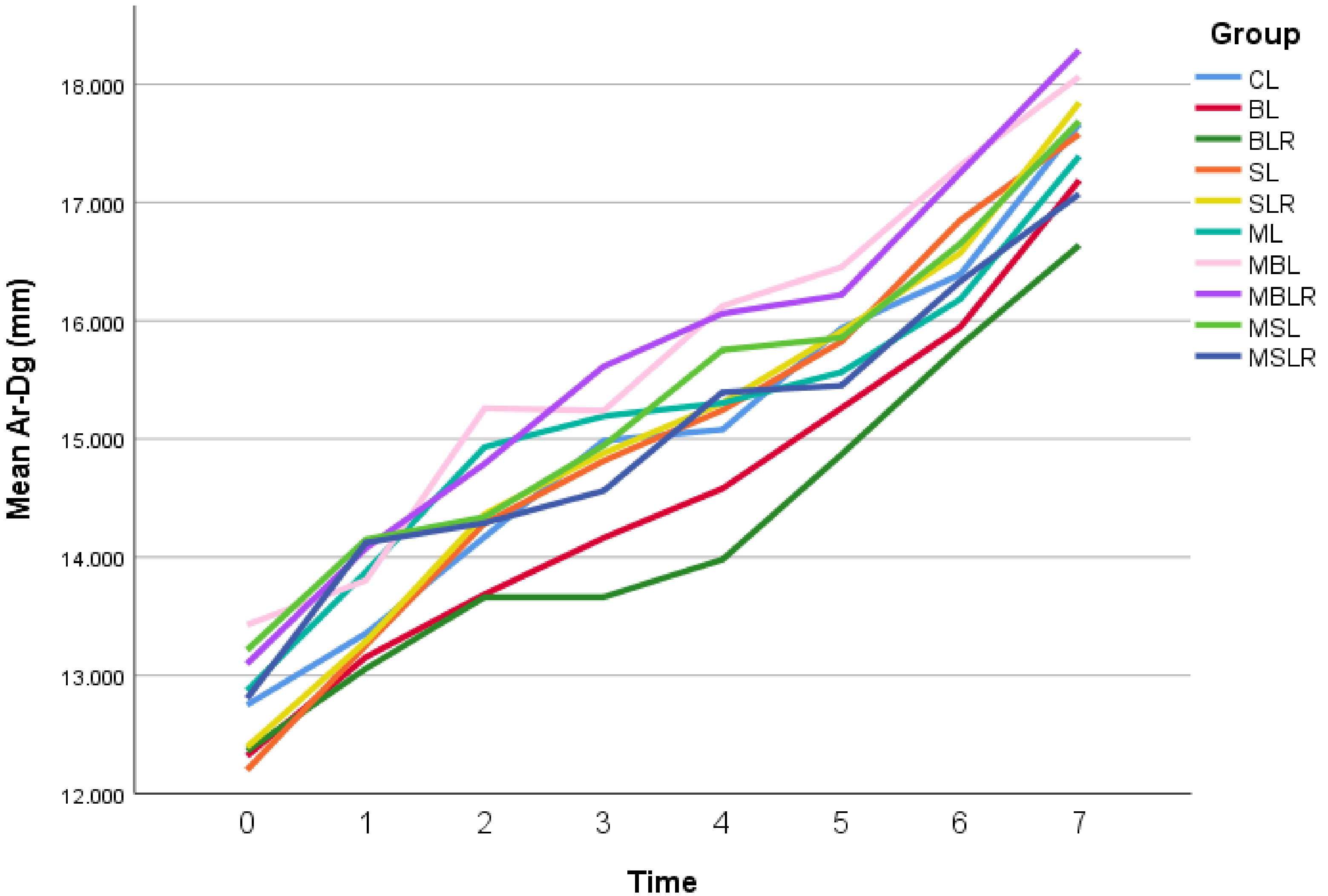


Figure 40: Line Graph of Mean Ar↔Dg (mm) for LC-LT groups from T0 to T7

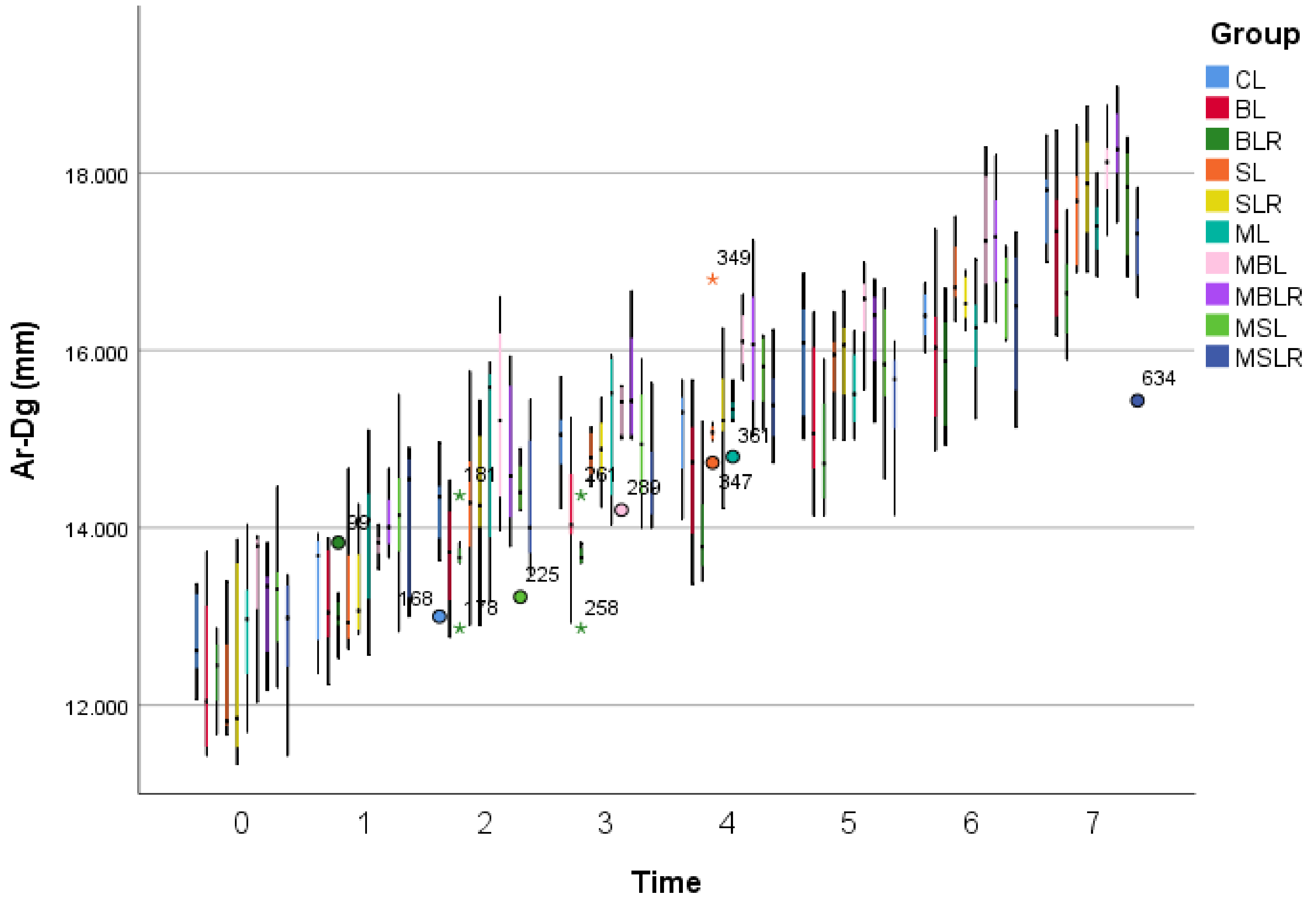


Figure 41: Boxplot of Ar↔Dg (mm) for LC-LT groups from T0 to T7

5.2.2.6 LC-LT Horizontal Position of the Condyle (xCo)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for xCo are displayed below (Table XXVIII). A line graph of the group means and a boxplot of xCo are displayed below in Figures 42 and 43. At T0, similarly to the ST groups there were no significant differences between the groups with respect to the anteroposterior position of xCo. At T1, T2, T3, and T4 the ML, MBL, MBLR, MSL, and MSLR groups had significantly more anterior xCo positions than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). However after T5 only the MBL and MBLR groups had significantly more anterior xCo positions than all groups except the ML group ($p \leq 0.001$). The MSL and the MSLR groups had more anterior xCo positions than the CL, BLR, and SL groups ($p \leq 0.01$). At T6 the MBL and MBLR groups had significantly more anterior xCo positions than all groups except the ML group ($p \leq 0.01$). At T7 the MBL and MBLR groups had significantly more forward xCo measurements than all other groups ($p \leq 0.01$) although they were not significantly different from each other.

Table XXVIII: Multiple Comparisons Within Groups LC-LT for xCo

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.05	0.08	1.00	-0.44	0.35	ML	0	1	-0.99*	0.09	0.00	-1.44	-0.56
		2	0.03	0.09	1.00	-0.41	0.47			2	-0.97*	0.09	0.00	-1.47	-0.48
		3	0.11	0.12	1.00	-0.51	0.73			3	-0.79*	0.08	0.00	-1.19	-0.39
		4	0.17	0.09	0.93	-0.29	0.63			4	-0.83*	0.07	0.00	-1.14	-0.52
		5	-0.03	0.06	1.00	-0.32	0.27			5	-0.30	0.12	0.61	-0.97	0.37
		6	0.19	0.08	0.68	-0.21	0.59			6	-0.21	0.10	0.77	-0.72	0.30
		7	0.08	0.08	1.00	-0.30	0.46			7	-0.18	0.05	0.09	-0.43	0.06
	1	2	0.08	0.10	1.00	-0.39	0.55		1	2	0.02	0.11	1.00	-0.51	0.56
		3	0.16	0.13	1.00	-0.46	0.77			3	0.21	0.10	0.84	-0.27	0.68
		4	0.22	0.10	0.80	-0.27	0.70			4	0.17	0.09	0.93	-0.28	0.61
		5	0.02	0.08	1.00	-0.37	0.41			5	0.69*	0.14	0.01	0.04	1.36
		6	0.24	0.10	0.53	-0.21	0.69			6	0.78*	0.12	0.00	0.24	1.33
		7	0.13	0.09	1.00	-0.30	0.57			7	0.81*	0.08	0.00	0.36	1.27
	2	3	0.08	0.13	1.00	-0.55	0.70		2	3	0.18	0.11	0.97	-0.34	0.70
		4	0.14	0.11	1.00	-0.37	0.65			4	0.14	0.10	1.00	-0.35	0.64
		5	-0.06	0.09	1.00	-0.50	0.38			5	0.67*	0.14	0.01	0.00	1.35
		6	0.16	0.10	0.99	-0.32	0.63			6	0.76*	0.12	0.00	0.19	1.33
			0.05	0.10	1.00	-0.42	0.52			7	0.795	0.09	0.00	0.28	1.31

	3	4	0.06	0.13	1.00	-0.57	0.69		3	4	-0.04	0.09	1.00	-0.45	0.37
		5	-0.14	0.11	1.00	-0.76	0.49			5	0.49	0.13	0.08	-0.16	1.15
		6	0.08	0.13	1.00	-0.54	0.70			6	0.58*	0.11	0.00	0.05	1.11
		7	-0.02	0.12	1.00	-0.64	0.59			7	0.61*	0.07	0.00	0.20	1.02
	4	5	-0.20	0.09	0.77	-0.65	0.26		4	5	0.53	0.12	0.05	-0.13	1.19
		6	0.02	0.10	1.00	-0.47	0.51			6	0.61*	0.10	0.00	0.11	1.13
		7	-0.09	0.10	1.00	-0.57	0.40			7	0.65*	0.06	0.00	0.35	0.95
	5	6	0.22	0.08	0.43	-0.18	0.62		5	6	0.09	0.14	1.00	-0.59	0.76
		7	0.11	0.08	1.00	-0.27	0.49			7	0.12	0.11	1.00	-0.58	0.82
	6	7	-0.11	0.09	1.00	-0.55	0.33		6	7	0.03	0.09	1.00	-0.50	0.57
BL	0	1	-0.12	0.08	1.00	-0.51	0.27	MBL	0	1	-0.69*	0.06	0.00	-0.96	-0.44
		2	0.05	0.07	1.00	-0.28	0.39			2	-0.65*	0.10	0.00	-1.23	-0.09
		3	0.05	0.10	1.00	-0.43	0.53			3	-0.71*	0.07	0.00	-1.06	-0.37
		4	0.23	0.07	0.19	-0.11	0.57			4	-0.58*	0.07	0.00	-0.91	-0.26
		5	-0.01	0.10	1.00	-0.54	0.53			5	-0.56*	0.05	0.00	-0.78	-0.35
		6	0.04	0.09	1.00	-0.39	0.46			6	-0.52*	0.04	0.00	-0.72	-0.32
		7	0.10	0.10	1.00	-0.39	0.58			7	-0.49*	0.04	0.00	-0.70	-0.29
	1	2	0.17	0.08	0.84	-0.23	0.56		1	2	0.04	0.10	1.00	-0.52	0.60
		3	0.16	0.10	0.99	-0.33	0.66			3	-0.02	0.07	1.00	-0.37	0.33
		4	0.35	0.08	0.03	-0.05	0.75			4	0.11	0.07	0.98	-0.22	0.45
		5	0.11	0.11	1.00	-0.43	0.65			5	0.13	0.05	0.52	-0.12	0.38
		6	0.15	0.10	0.99	-0.30	0.60			6	0.18	0.05	0.11	-0.07	0.43
		7	0.21	0.11	0.86	-0.29	0.72			7	0.20	0.05	0.05	-0.05	0.45
	2	3	0.00	0.10	1.00	-0.49	0.48		2	3	-0.06	0.11	1.00	-0.61	0.50
		4	0.18	0.08	0.63	-0.18	0.53			4	0.07	0.11	1.00	-0.48	0.63
		5	-0.06	0.11	1.00	-0.59	0.48			5	0.09	0.10	1.00	-0.48	0.67
		6	-0.02	0.09	1.00	-0.44	0.41			6	0.14	0.10	1.00	-0.45	0.72
		7	0.04	0.10	1.00	-0.45	0.53			7	0.16	0.10	0.99	-0.42	0.75
	3	4	0.18	0.10	0.93	-0.30	0.66		3	4	0.13	0.08	0.98	-0.25	0.51
		5	-0.05	0.12	1.00	-0.63	0.53			5	0.15	0.07	0.75	-0.20	0.50
		6	-0.01	0.11	1.00	-0.52	0.50			6	0.19	0.06	0.32	-0.16	0.55
		7	0.05	0.12	1.00	-0.50	0.60			7	0.22	0.06	0.19	-0.13	0.57
	4	5	-0.24	0.11	0.76	-0.77	0.30		4	5	0.02	0.06	1.00	-0.31	0.34
		6	-0.19	0.09	0.77	-0.62	0.24			6	0.06	0.06	1.00	-0.27	0.39
		7	-0.13	0.10	1.00	-0.62	0.36			7	0.09	0.06	1.00	-0.24	0.42
		6	0.04	0.12	1.00	-0.51	0.60			6	0.05	0.04	1.00	-0.13	0.22

	5	7	0.10	0.12	1.00	-0.48	0.68		5	7	0.07	0.04	0.94	-0.11	0.25
	6	7	0.06	0.11	1.00	-0.46	0.58		6	7	0.02	0.03	1.00	-0.13	0.18
BLR	0	1	0.22	0.11	0.79	-0.27	0.71	MBLR	0	1	-0.64*	0.08	0.00	-1.05	-0.24
		2	0.25	0.09	0.33	-0.17	0.67			2	-0.80*	0.10	0.00	-1.27	-0.35
		3	0.04	0.09	1.00	-0.38	0.46			3	-0.92*	0.11	0.00	-1.46	-0.39
		4	-0.02	0.10	1.00	-0.49	0.46			4	-0.76*	0.09	0.00	-1.20	-0.32
		5	0.04	0.10	1.00	-0.43	0.51			5	-0.71*	0.07	0.00	-1.14	-0.30
		6	0.01	0.09	1.00	-0.41	0.42			6	-0.71*	0.07	0.00	-1.13	-0.29
		7	0.04	0.10	1.00	-0.44	0.52			7	-0.70*	0.07	0.00	-1.12	-0.28
	1	2	0.03	0.09	1.00	-0.43	0.49		1	2	-0.16	0.08	0.86	-0.58	0.25
		3	-0.18	0.09	0.90	-0.64	0.28			3	-0.28	0.10	0.37	-0.80	0.24
		4	-0.24	0.11	0.72	-0.74	0.27			4	-0.12	0.07	0.99	-0.49	0.25
		5	-0.18	0.11	0.96	-0.68	0.32			5	-0.07	0.05	0.98	-0.30	0.16
		6	-0.21	0.09	0.68	-0.67	0.24			6	-0.07	0.05	0.99	-0.30	0.16
		7	-0.18	0.11	0.97	-0.69	0.32			7	-0.06	0.04	1.00	-0.29	0.17
	2	3	-0.21	0.07	0.33	-0.56	0.14		2	3	-0.12	0.11	1.00	-0.65	0.42
		4	-0.27	0.09	0.29	-0.70	0.17			4	0.05	0.09	1.00	-0.40	0.49
		5	-0.21	0.09	0.63	-0.64	0.22			5	0.09	0.07	1.00	-0.34	0.52
		6	-0.24	0.07	0.14	-0.59	0.10			6	0.10	0.07	1.00	-0.33	0.52
		7	-0.21	0.09	0.67	-0.65	0.23			7	0.11	0.07	1.00	-0.32	0.53
	3	4	-0.06	0.09	1.00	-0.49	0.38		3	4	0.16	0.11	0.99	-0.36	0.69
		5	0.00	0.09	1.00	-0.43	0.43			5	0.21	0.09	0.79	-0.34	0.75
		6	-0.03	0.07	1.00	-0.37	0.31			6	0.21	0.09	0.75	-0.33	0.76
		7	0.00	0.09	1.00	-0.44	0.44			7	0.22	0.09	0.69	-0.32	0.77
	4	5	0.06	0.10	1.00	-0.43	0.54		4	5	0.04	0.07	1.00	-0.34	0.42
		6	0.02	0.09	1.00	-0.41	0.46			6	0.05	0.07	1.00	-0.33	0.43
		7	0.06	0.10	1.00	-0.43	0.54			7	0.06	0.07	1.00	-0.32	0.44
	5	6	-0.03	0.09	1.00	-0.46	0.39		5	6	0.01	0.03	1.00	-0.14	0.15
		7	0.00	0.10	1.00	-0.48	0.48			7	0.02	0.03	1.00	-0.13	0.16
	6	7	0.03	0.09	1.00	-0.40	0.47		6	7	0.01	0.03	1.00	-0.13	0.15
SL	0	1	0.22	0.12	0.94	-0.39	0.84	MSL	0	1	-1.05*	0.13	0.00	-1.66	-0.46
		2	0.08	0.11	1.00	-0.49	0.64			2	-0.98*	0.12	0.00	-1.57	-0.41
		3	-0.03	0.08	1.00	-0.39	0.33			3	-0.94*	0.11	0.00	-1.52	-0.37
		4	0.04	0.09	1.00	-0.37	0.46			4	-.85*	0.10	0.00	-1.45	-0.26
		5	0.12	0.10	1.00	-0.35	0.60			5	-0.51	0.11	0.02	-1.09	0.06
		6	0.11	0.11	1.00	-0.41	0.62			6	-0.21	0.12	0.96	-0.80	0.38

		7	0.05	0.11	1.00	-0.47	0.56			7	-0.20	0.11	0.96	-0.77	0.37
	1	2	-0.14	0.14	1.00	-0.82	0.53		1	2	0.07	0.11	1.00	-0.43	0.57
		3	-0.25	0.12	0.81	-0.87	0.37			3	0.11	0.09	1.00	-0.36	0.58
		4	-0.18	0.13	1.00	-0.80	0.44			4	0.21	0.09	0.69	-0.28	0.69
		5	-0.10	0.13	1.00	-0.74	0.53			5	0.54*	0.09	0.00	0.08	1.02
		6	-0.12	0.14	1.00	-0.77	0.53			6	0.84*	0.11	0.00	0.34	1.36
		7	-0.18	0.14	1.00	-0.82	0.47			7	0.86*	0.10	0.00	0.39	1.34
	2	3	-0.11	0.11	1.00	-0.67	0.46		2	3	0.04	0.09	1.00	-0.37	0.45
		4	-0.03	0.12	1.00	-0.60	0.54			4	0.13	0.08	0.97	-0.28	0.54
		5	0.04	0.13	1.00	-0.55	0.64			5	0.47*	0.08	0.00	0.07	0.88
		6	0.03	0.13	1.00	-0.58	0.64			6	0.77*	0.10	0.00	0.30	1.25
		7	-0.03	0.13	1.00	-0.64	0.58			7	0.78*	0.09	0.00	0.37	1.21
	3	4	0.07	0.08	1.00	-0.32	0.46		3	4	0.09	0.06	0.98	-0.20	0.38
		5	0.15	0.09	0.98	-0.32	0.61			5	0.43*	0.07	0.00	0.12	0.75
		6	0.13	0.10	1.00	-0.37	0.64			6	0.73*	0.09	0.00	0.30	1.17
		7	0.07	0.10	1.00	-0.43	0.58			7	0.748*	0.07	0.00	0.40	1.09
	4	5	0.08	0.10	1.00	-0.41	0.56		4	5	0.34*	0.05	0.00	0.09	0.60
		6	0.06	0.11	1.00	-0.46	0.58			6	0.64*	0.08	0.00	0.20	1.08
		7	0.00	0.11	1.00	-0.52	0.52			7	0.65*	0.06	0.00	0.34	0.97
	5	6	-0.01	0.12	1.00	-0.57	0.54		5	6	0.30	0.09	0.13	-0.13	0.73
		7	-0.07	0.12	1.00	-0.63	0.48			7	0.31	0.07	0.02	-0.01	0.64
	6	7	-0.06	0.12	1.00	-0.63	0.52		6	7	0.01	0.09	1.00	-0.43	0.45
SLR	0	1	0.12	0.12	1.00	-0.45	0.68	MSLR	0	1	-0.99*	0.14	0.00	-1.64	-0.36
		2	-0.04	0.11	1.00	-0.56	0.47			2	-1.05*	0.12	0.00	-1.63	-0.48
		3	-0.02	0.10	1.00	-0.50	0.47			3	-1.02*	0.12	0.00	-1.60	-0.44
		4	-0.02	0.10	1.00	-0.51	0.47			4	-0.8*	0.10	0.00	-1.48	-0.29
		5	0.02	0.12	1.00	-0.53	0.57			5	-0.54	0.11	0.02	-1.12	0.03
		6	-0.06	0.10	1.00	-0.55	0.43			6	-0.19	0.11	0.95	-0.78	0.39
		7	-0.01	0.10	1.00	-0.50	0.47			7	-0.23	0.11	0.83	-0.81	0.35
	1	2	-0.16	0.11	1.00	-0.69	0.37		1	2	-0.06	0.11	1.00	-0.62	0.50
		3	-0.13	0.10	1.00	-0.64	0.38			3	-0.02	0.11	1.00	-0.58	0.53
		4	-0.14	0.10	1.00	-0.65	0.38			4	0.11	0.10	1.00	-0.46	0.68
		5	-0.10	0.12	1.00	-0.66	0.47			5	0.45	0.11	0.04	-0.10	1.01
		6	-0.18	0.10	0.95	-0.69	0.33			6	0.85*	0.10	0.00	0.24	1.37
		7	-0.13	0.10	1.00	-0.64	0.38			7	0.76*	0.11	0.00	0.21	1.32
		3	0.03	0.08	1.00	-0.38	0.43			3	0.03	0.09	1.00	-0.38	0.45

	2	4	0.02	0.09	1.00	-0.39	0.44		2	4	0.17	0.07	0.68	-0.20	0.53
		5	0.06	0.11	1.00	-0.44	0.57			5	0.51*	0.08	0.00	0.13	0.90
		6	-0.02	0.08	1.00	-0.42	0.39			6	0.86*	0.07	0.00	0.49	1.23
		7	0.03	0.08	1.00	-0.38	0.43			7	0.82*	0.08	0.00	0.45	1.20
	3	4	0.00	0.07	1.00	-0.35	0.34		3	4	0.13	0.07	0.93	-0.24	0.50
		5	0.04	0.10	1.00	-0.44	0.51			5	0.47*	0.08	0.00	0.09	0.86
		6	-0.05	0.07	1.00	-0.37	0.28			6	0.82*	0.07	0.00	0.46	1.20
		7	0.00	0.07	1.00	-0.32	0.32			7	0.79*	0.08	0.00	0.41	1.17
	4	5	0.04	0.10	1.00	-0.44	0.52		4	5	0.34*	0.06	0.00	0.05	0.64
		6	-0.04	0.07	1.00	-0.39	0.30			6	0.69*	0.05	0.00	0.46	0.93
		7	0.01	0.07	1.00	-0.34	0.35			7	0.65*	0.06	0.00	0.38	0.94
	5	6	-0.08	0.10	1.00	-0.56	0.40		5	6	0.34*	0.06	0.00	0.04	0.66
		7	-0.03	0.09	1.00	-0.51	0.44			7	0.31*	0.07	0.01	-0.01	0.64
	6	7	0.05	0.07	1.00	-0.27	0.36		6	0	0.19	0.11	0.95	-0.39	0.78

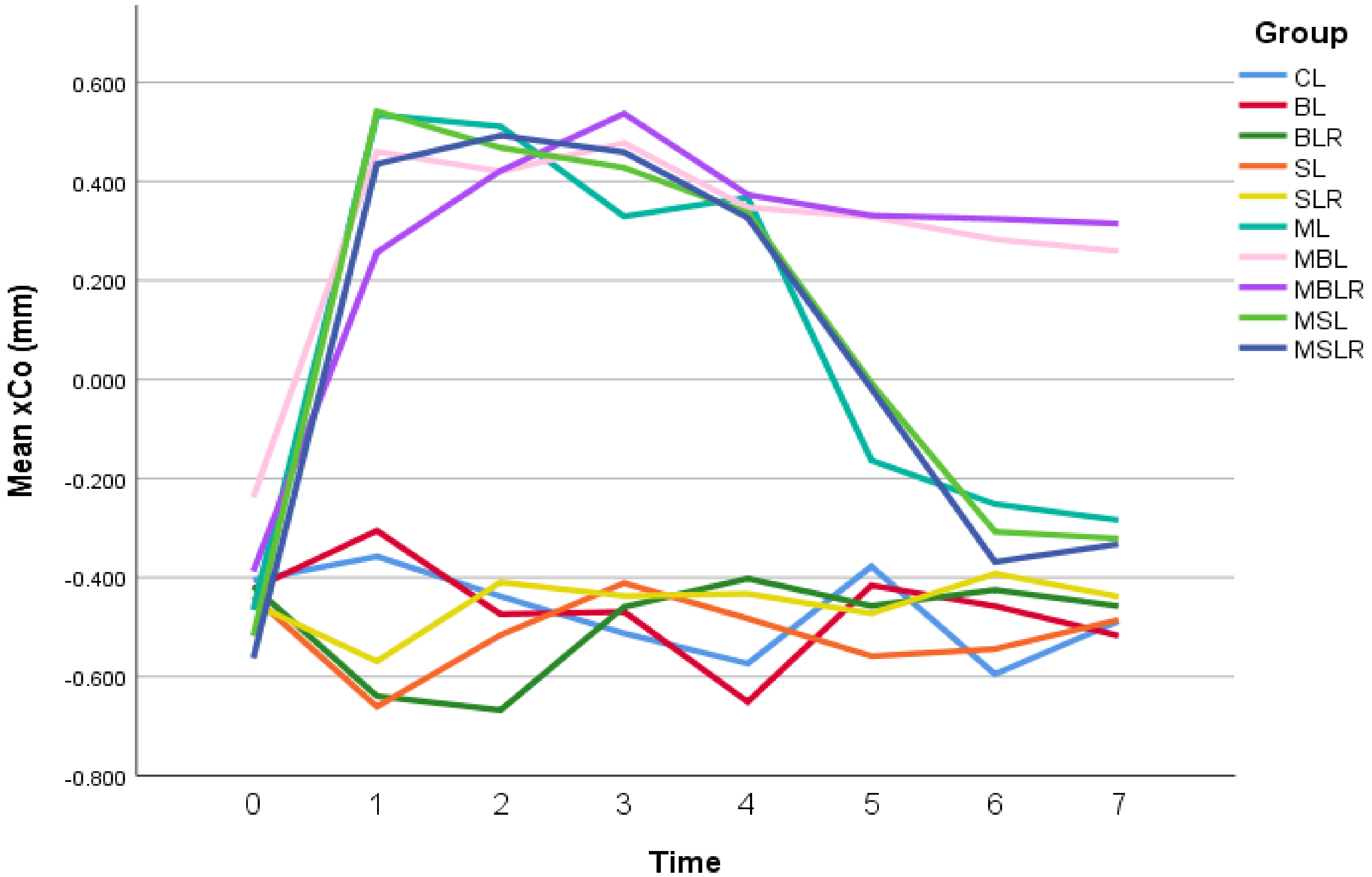


Figure 42: Line Graph of Mean xCo (mm) for LC-LT groups from T0 to T7

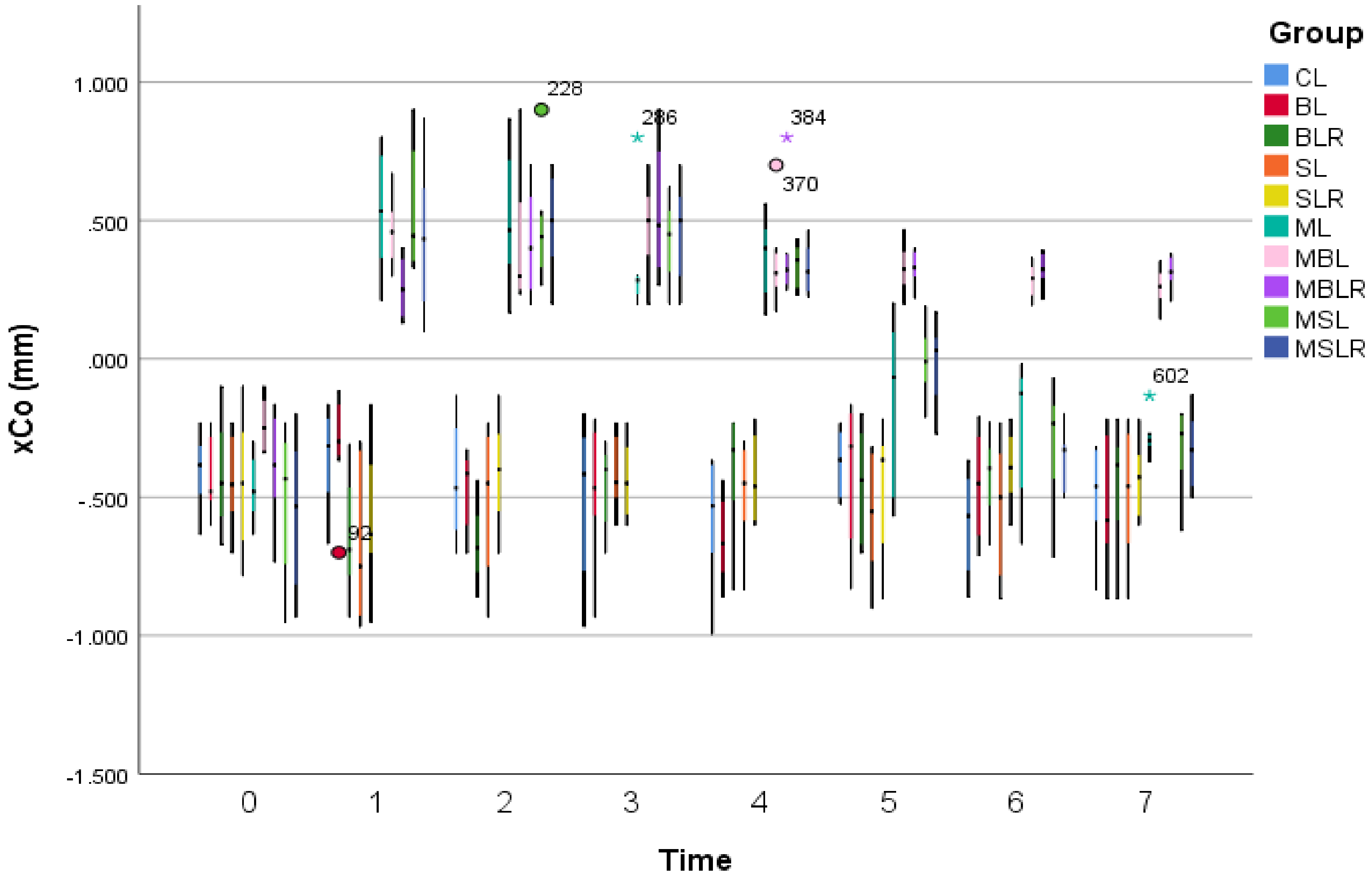


Figure 43: Boxplot of xCo (mm) for LC-LT groups from T0 to T7

5.2.2.7 LC-LT Vertical Height of Mandibular Ramus (Co to Mn)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Co↔Mn are displayed below (Table XXIX). A line graph of the group means and a boxplot of Co↔Mn are displayed below in Figures 44 and 45. Similarly to the LC-ST groups there were no significant differences between the groups at T0 to T3 for the vertical height of the mandibular ramus. At T4 the BLR group had a significantly shorter ramal height (Co↔Mn) than the CL, SL, and SLR groups ($p \leq 0.01$). The MBLR group had a significantly shorter ramal height (Co↔Mn) than the CL and SL groups ($p \leq 0.01$). At T5 the BLR group had a significantly shorter ramal height (Co↔Mn) than the CL and SL groups ($p \leq 0.001$). The MBLR group had a significantly shorter ramal height (Co↔Mn) than the CL, SL, and SLR groups ($p \leq 0.001$). At T6 the BLR group had a significantly shorter ramal height (Co↔Mn) than the MBL group ($p \leq 0.001$). The MBLR group had a significantly shorter ramal height (Co↔Mn) than the MSL groups ($p \leq 0.001$). At T7 the BLR group had a significantly shorter ramal height (Co↔Mn) than the SLR group ($p \leq 0.01$).

Table XXIX: Multiple Comparisons Within Groups LC-LT for Co to Mn

Group	Time (I)	Time J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.36	0.25	0.99	-1.51	0.80	ML	0	1	0.11	0.25	1.00	-1.11	1.33
		2	-0.65	0.22	0.30	-1.72	0.42			2	-0.08	0.22	1.00	-1.13	0.96
		3	-1.06	0.26	0.03	-2.29	0.17			3	0.14	0.26	1.00	-1.20	1.48
		4	-1.57*	0.24	0.00	-2.69	-0.45			4	-0.80	0.26	0.23	-2.09	0.49
		5	-2.15*	0.22	0.00	-3.22	-1.08			5	-1.12	0.27	0.05	-2.51	0.28
		6	-2.68*	0.38	0.00	-4.66	-0.71			6	-1.78*	0.19	0.00	-2.68	-0.88
		7	-3.08*	0.26	0.00	-4.30	-1.86			7	-2.43*	0.16	0.00	-3.21	-1.66
	1	2	-0.29	0.21	1.00	-1.31	0.73		1	2	-0.19	0.27	1.00	-1.48	1.10
		3	-0.71	0.26	0.35	-1.90	0.49			3	0.03	0.31	1.00	-1.43	1.49
		4	-1.21*	0.23	0.00	-2.28	-0.14			4	-0.91	0.30	0.24	-2.34	0.52
		5	-1.79*	0.21	0.00	-2.81	-0.78			5	-1.23	0.32	0.05	-2.73	0.27
		6	-2.32*	0.38	0.00	-4.30	-0.35			6	-1.89*	0.25	0.00	-3.13	-0.66
		7	-2.72*	0.25	0.00	-3.91	-1.54			7	-2.54*	0.23	0.00	-3.77	-1.33
	2	3	-0.41	0.23	0.95	-1.54	0.71		2	3	0.22	0.29	1.00	-1.16	1.61
		4	-0.92*	0.20	0.01	-1.88	0.04			4	-0.72	0.28	0.50	-2.06	0.62
		5	-1.50*	0.19	0.00	-2.37	-0.63			5	-1.04	0.30	0.11	-2.46	0.39
		6	-2.03*	0.36	0.01	-4.04	-0.02			6	-1.70*	0.23	0.00	-2.77	-0.63

		7	-2.43*	0.23	0.00	-3.54	-1.32			7	-2.35*	0.20	0.00	-3.38	-1.33
	3	4	-0.51	0.25	0.82	-1.67	0.66		3	4	-0.94	0.32	0.26	-2.44	0.55
		5	-1.09*	0.23	0.01	-2.21	0.04			5	-1.26	0.33	0.06	-2.82	0.30
		6	-1.62	0.39	0.04	-3.59	0.36			6	-1.92*	0.27	0.00	-3.27	-0.58
		7	-2.01*	0.27	0.00	-3.27	-0.76			7	-2.57*	0.25	0.00	-3.93	-1.22
	4	5	-0.58	0.20	0.30	-1.53	0.37		4	5	-0.32	0.33	1.00	-1.85	1.21
		6	-1.11	0.37	0.33	-3.10	0.88			6	-0.98	0.26	0.08	-2.28	0.31
		7	-1.51*	0.24	0.00	-2.66	-0.36			7	-1.63*	0.24	0.00	-2.93	-0.34
	5	6	-0.53	0.36	1.00	-2.55	1.48		5	6	-0.66	0.28	0.64	-2.06	0.73
		7	-0.93	0.23	0.04	-2.04	0.18			7	-1.32	0.26	0.02	-2.73	0.09
	6	7	-0.40	0.39	1.00	-2.37	1.57		6	7	-0.65	0.18	0.07	-1.50	0.20
	0	1	0.01	0.31	1.00	-1.46	1.48		0	1	0.00	0.20	1.00	-0.95	0.95
		2	-0.80	0.29	0.35	-2.17	0.57			2	0.07	0.22	1.00	-0.95	1.09
		3	-0.87	0.25	0.16	-2.18	0.44			3	-0.14	0.25	1.00	-1.35	1.07
		4	-1.13	0.33	0.11	-2.69	0.43			4	-0.55	0.24	0.69	-1.70	0.61
		5	-1.43	0.32	0.02	-2.94	0.09			5	-1.11*	0.24	0.01	-2.26	0.03
		6	-1.83*	0.34	0.00	-3.43	-0.24			6	-2.01*	0.18	0.00	-2.88	-1.15
		7	-2.54*	0.42	0.00	-4.63	-0.47			7	-2.09*	0.20	0.00	-3.02	-1.16
	1	2	-0.81	0.28	0.31	-2.15	0.53		1	2	0.07	0.22	1.00	-0.95	1.09
		3	-0.88	0.25	0.13	-2.15	0.40	MBL		3	-0.14	0.25	1.00	-1.35	1.07
		4	-1.14	0.33	0.10	-2.68	0.40			4	-0.55	0.24	0.69	-1.70	0.61
		5	-1.43*	0.32	0.01	-2.93	0.06			5	-1.11	0.24	0.01	-2.26	0.03
		6	-1.84*	0.34	0.00	-3.42	-0.26			6	-2.01*	0.18	0.00	-2.88	-1.15
BL		7	-2.55*	0.42	0.00	-4.63	-0.48			7	-2.09*	0.20	0.00	-3.02	-1.16
	2	3	-0.07	0.21	1.00	-1.12	0.99		2	3	-0.21	0.26	1.00	-1.46	1.03
		4	-0.33	0.30	1.00	-1.78	1.13			4	-0.62	0.25	0.55	-1.81	0.57
		5	-0.62	0.29	0.79	-2.02	0.78			5	-1.18*	0.25	0.01	-2.37	0.00
		6	-1.03	0.31	0.15	-2.54	0.47			6	-2.08*	0.20	0.00	-3.04	-1.13
		7	-1.75	0.40	0.04	-3.82	0.33			7	-2.16*	0.21	0.00	-3.17	-1.16
	3	4	-0.26	0.27	1.00	-1.69	1.16		3	4	-0.41	0.28	1.00	-1.73	0.91
		5	-0.56	0.26	0.81	-1.91	0.80			5	-0.97	0.28	0.10	-2.28	0.34
		6	-0.97	0.28	0.16	-2.46	0.53			6	-1.87*	0.23	0.00	-3.06	-0.68
		7	-1.68	0.37	0.05	-3.82	0.46			7	-1.95*	0.25	0.00	-3.15	-0.75
	4	5	-0.29	0.34	1.00	-1.87	1.28		4	5	-0.56	0.27	0.81	-1.84	0.71
		6	-0.70	0.35	0.85	-2.35	0.95			6	-1.46*	0.22	0.00	-2.59	-0.34
		7	-1.42	0.43	0.16	-3.51	0.68			7	-1.54*	0.24	0.00	-2.69	-0.40

	5	6	-0.41	0.35	1.00	-2.03	1.21		5	6	-0.90	0.22	0.05	-2.01	0.21
		7	-1.12	0.43	0.46	-3.21	0.96			7	-0.98	0.24	0.03	-2.11	0.15
	6	7	-0.71	0.44	0.98	-2.82	1.40		6	7	-0.08	0.18	1.00	-0.91	0.75
BLR	0	1	-0.15	0.32	1.00	-1.89	1.59	MBLR	0	1	-0.06	0.31	1.00	-1.73	1.61
		2	-0.40	0.34	1.00	-2.12	1.32			2	-0.10	0.29	1.00	-1.62	1.42
		3	-0.15	0.32	1.00	-1.91	1.61			3	-0.30	0.22	1.00	-1.38	0.78
		4	0.16	0.38	1.00	-1.63	1.95			4	0.04	0.17	1.00	-0.75	0.83
		5	-0.84	0.31	0.52	-2.62	0.93			5	-0.58	0.21	0.39	-1.60	0.44
		6	-1.21	0.33	0.11	-2.93	0.52			6	-1.47*	0.24	0.00	-2.65	-0.30
		7	-2.17*	0.34	0.00	-3.89	-0.45			7	-2.39*	0.23	0.00	-3.53	-1.26
	1	2	-0.25	0.21	1.00	-1.27	0.77		1	2	-0.05	0.39	1.00	-1.85	1.76
		3	0.00	0.17	1.00	-0.80	0.80			3	-0.24	0.34	1.00	-1.91	1.42
		4	0.31	0.27	1.00	-1.04	1.66			4	0.10	0.31	1.00	-1.59	1.78
		5	-0.69	0.16	0.03	-1.48	0.09			5	-0.52	0.33	0.99	-2.18	1.13
		6	-1.05*	0.20	0.00	-1.99	-0.13			6	-1.42	0.35	0.04	-3.10	0.26
		7	-2.02*	0.21	0.00	-3.05	-1.00			7	-2.34*	0.34	0.00	-4.02	-0.67
	2	3	0.25	0.20	1.00	-0.74	1.24		2	3	-0.20	0.32	1.00	-1.74	1.34
		4	0.56	0.29	0.88	-0.82	1.94			4	0.14	0.28	1.00	-1.39	1.67
		5	-0.44	0.20	0.73	-1.43	0.55			5	-0.48	0.31	0.99	-2.01	1.05
		6	-0.80	0.23	0.09	-1.86	0.26			6	-1.37	0.33	0.03	-2.94	0.19
		7	-1.77*	0.24	0.00	-2.89	-0.65			7	-2.29*	0.32	0.00	-3.85	-0.74
	3	4	0.31	0.26	1.00	-1.05	1.67		3	4	0.34	0.21	0.99	-0.73	1.41
		5	-0.69*	0.15	0.01	-1.39	0.00			5	-0.28	0.25	1.00	-1.46	0.89
		6	-1.05*	0.18	0.00	-1.94	-0.17			6	-1.18	0.27	0.02	-2.45	0.10
		7	-2.02*	0.20	0.00	-3.02	-1.03			7	-2.09*	0.27	0.00	-3.35	-0.85
	4	5	-1.00	0.25	0.08	-2.37	0.36		4	5	-0.62	0.21	0.26	-1.63	0.39
		6	-1.36*	0.28	0.01	-2.72	-0.01			6	-1.51*	0.23	0.00	-2.69	-0.35
		7	-2.33*	0.29	0.00	-3.71	-0.95			7	-2.43*	0.22	0.00	-3.57	-1.31
	5	6	-0.36	0.18	0.85	-1.24	0.51		5	6	-0.90	0.26	0.12	-2.14	0.35
		7	-1.32*	0.20	0.00	-2.32	-0.34			7	-1.81*	0.26	0.00	-3.03	-0.60
	6	7	-0.97	0.23	0.02	-2.03	0.09		6	7	-0.92	0.28	0.14	-2.23	0.38
SL	0	1	-0.29	0.38	1.00	-2.28	1.70	MSL	0	1	-0.03	0.28	1.00	-1.36	1.31
		2	-1.02	0.35	0.43	-3.11	1.07			2	-0.32	0.28	1.00	-1.67	1.03
		3	-0.79	0.38	0.84	-2.79	1.21			3	-0.49	0.33	0.99	-2.20	1.22
		4	-1.54	0.41	0.07	-3.54	0.47			4	-0.95	0.37	0.56	-2.92	1.02
		5	-1.87	0.35	0.02	-3.95	0.21			5	-1.72*	0.21	0.00	-2.73	-0.72

		6	-2.50*	0.51	0.01	-4.91	-0.10			6	-2.64*	0.25	0.00	-3.83	-1.46
		7	-3.20*	0.41	0.00	-5.21	-1.20			7	-2.71*	0.32	0.00	-4.35	-1.08
	1	2	-0.73	0.20	0.10	-1.75	0.29		1	2	-0.29	0.32	1.00	-1.80	1.21
		3	-0.50	0.24	0.78	-1.61	0.61			3	-0.47	0.37	1.00	-2.23	1.30
		4	-1.25	0.29	0.02	-2.62	0.13			4	-0.93	0.41	0.69	-2.91	1.05
		5	-1.58*	0.20	0.00	-2.60	-0.56			5	-1.69*	0.27	0.00	-3.02	-0.38
		6	-2.21*	0.42	0.01	-4.46	0.03			6	-2.62*	0.30	0.00	-4.02	-1.22
		7	-2.91*	0.29	0.00	-4.30	-1.54			7	-2.68*	0.36	0.00	-4.40	-0.98
	2	3	0.24	0.18	1.00	-0.68	1.15		2	3	-0.17	0.37	1.00	-1.95	1.60
		4	-0.51	0.25	0.85	-1.87	0.84			4	-0.63	0.41	0.99	-2.62	1.35
		5	-0.84*	0.13	0.00	-1.45	-0.24			5	-1.40*	0.27	0.01	-2.74	-0.07
		6	-1.48	0.39	0.15	-3.85	0.89			6	-2.32*	0.30	0.00	-3.75	-0.91
		7	-2.18*	0.25	0.00	-3.55	-0.82			7	-2.39*	0.36	0.00	-4.11	-0.68
	3	4	-0.75	0.28	0.42	-2.10	0.60		3	4	-0.46	0.45	1.00	-2.56	1.64
		5	-1.08*	0.18	0.00	-2.00	-0.16			5	-1.23	0.33	0.10	-2.95	0.48
		6	-1.72	0.41	0.06	-3.97	0.54			6	-2.15*	0.35	0.00	-3.88	-0.43
		7	-2.41*	0.28	0.00	-3.77	-1.06			7	-2.22*	0.41	0.00	-4.13	-0.32
	4	5	-0.33	0.25	1.00	-1.68	1.01		4	5	-0.77	0.37	0.84	-2.76	1.21
		6	-0.97	0.45	0.78	-3.20	1.26			6	-1.69	0.39	0.03	-3.66	0.27
		7	-1.67*	0.32	0.00	-3.19	-0.16			7	-1.76	0.44	0.04	-3.83	0.31
	5	6	-0.63	0.39	0.99	-2.99	1.72		5	6	-0.92	0.24	0.06	-2.08	0.23
		7	-1.34	0.25	0.01	-2.69	0.02			7	-0.99	0.32	0.25	-2.63	0.65
	6	7	-0.70	0.45	0.99	-2.93	1.53		6	7	-0.07	0.34	1.00	-1.73	1.59
SLR	0	1	-0.71	0.41	0.96	-2.64	1.22	MSLR	0	1	-0.04	0.23	1.00	-1.12	1.04
		2	-1.37	0.37	0.06	-3.11	0.36			2	-0.26	0.30	1.00	-1.70	1.18
		3	-1.42	0.33	0.03	-3.09	0.25			3	-0.66	0.34	0.90	-2.37	1.04
		4	-2.00*	0.40	0.01	-3.88	-0.14			4	-1.41	0.41	0.15	-3.53	0.71
		5	-2.50*	0.39	0.00	-4.32	-0.68			5	-1.75*	0.24	0.00	-2.87	-0.65
		6	-2.86*	0.39	0.00	-4.68	-1.04			6	-2.20*	0.38	0.00	-4.19	-0.22
		7	-3.72*	0.32	0.00	-5.40	-2.04			7	-2.82*	0.39	0.00	-4.82	-0.83
	1	2	-0.66	0.37	0.95	-2.45	1.12		1	2	-0.22	0.28	1.00	-1.63	1.18
		3	-0.71	0.34	0.82	-2.44	1.02			3	-0.62	0.32	0.91	-2.33	1.08
		4	-1.30	0.41	0.17	-3.21	0.61			4	-1.37	0.39	0.17	-3.53	0.79
		5	-1.79	0.40	0.01	-3.65	0.07			5	-1.71*	0.21	0.00	-2.68	-0.75
		6	-2.15*	0.40	0.00	-4.01	-0.29			6	-2.16*	0.37	0.01	-4.18	-0.15
		7	-3.01*	0.33	0.00	-4.75	-1.27			7	-2.78*	0.37	0.00	-4.82	-0.76

	2	3	-0.04	0.28	1.00	-1.38	1.30		2	3	-0.40	0.38	1.00	-2.19	1.39
		4	-0.64	0.36	0.95	-2.34	1.07			4	-1.14	0.44	0.46	-3.28	0.99
		5	-1.13	0.35	0.15	-2.76	0.50			5	-1.49*	0.29	0.01	-2.90	-0.08
		6	-1.49	0.35	0.02	-3.12	0.14			6	-1.94*	0.42	0.01	-3.96	0.07
		7	-2.34*	0.26	0.00	-3.67	-1.02			7	-2.56*	0.42	0.00	-4.59	-0.54
	3	4	-0.59	0.32	0.93	-2.21	1.03		3	4	-0.74	0.47	0.98	-2.95	1.46
		5	-1.08	0.30	0.11	-2.61	0.44			5	-1.09	0.33	0.19	-2.79	0.61
		6	-1.44	0.30	0.02	-2.97	0.08			6	-1.54	0.45	0.11	-3.65	0.57
		7	-2.30*	0.20	0.00	-3.26	-1.34			7	-2.16*	0.45	0.01	-4.29	-0.04
	4	5	-0.49	0.38	1.00	-2.28	1.29		4	5	-0.35	0.39	1.00	-2.49	1.79
		6	-0.85	0.38	0.71	-2.64	0.94			6	-0.80	0.50	0.98	-3.13	1.53
		7	-1.71*	0.31	0.01	-3.34	-0.09			7	-1.42	0.50	0.31	-3.76	0.92
	5	6	-0.36	0.37	1.00	-2.09	1.37		5	6	-0.45	0.37	1.00	-2.44	1.55
		7	-1.22	0.29	0.05	-2.74	0.30			7	-1.07	0.38	0.39	-3.08	0.94
	6	7	-0.86	0.29	0.34	-2.38	0.66		6	7	-0.62	0.48	1.00	-2.88	1.63

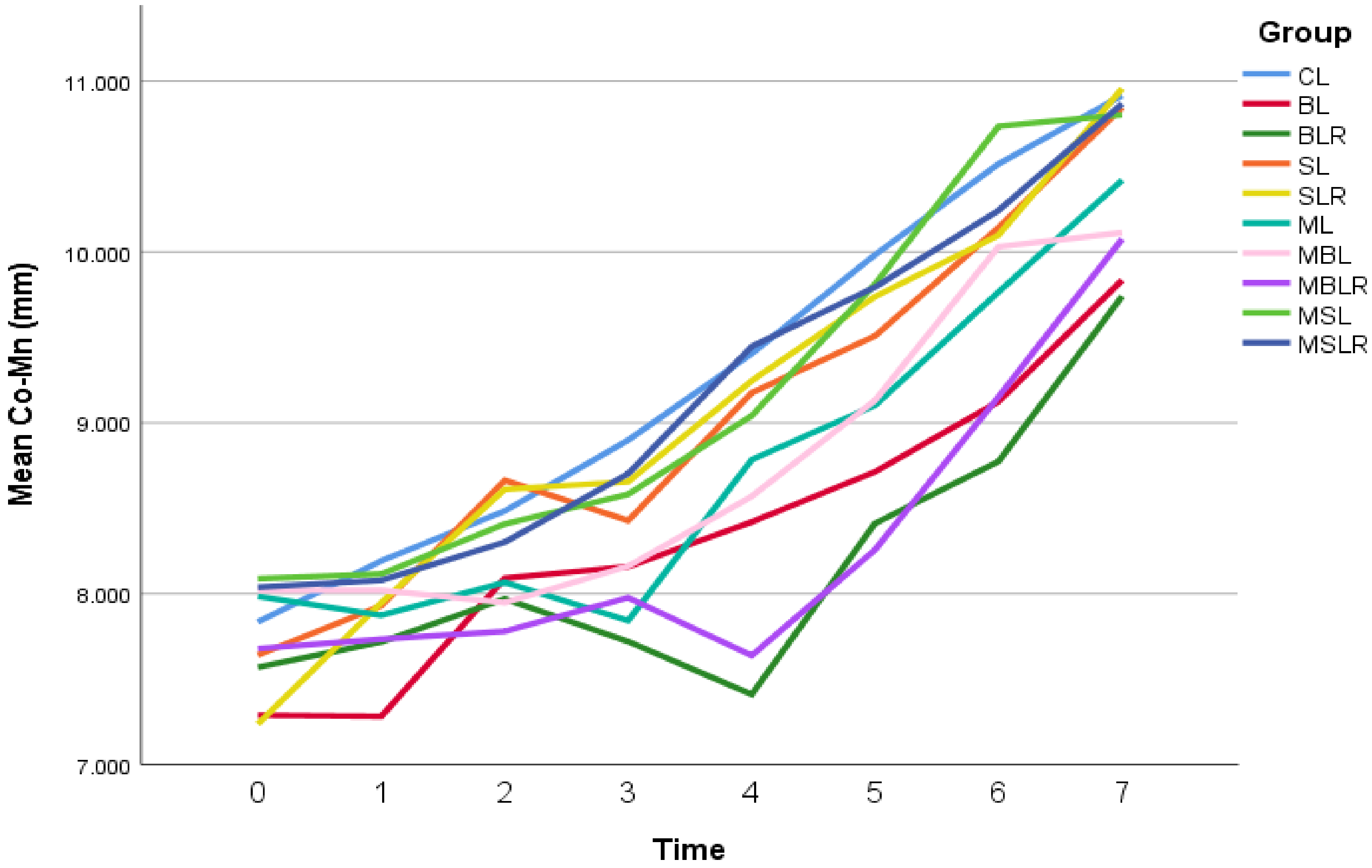


Figure 44: Line Graph of mean Co↔Mn (mm) for LC-LT Groups from T0 to T7

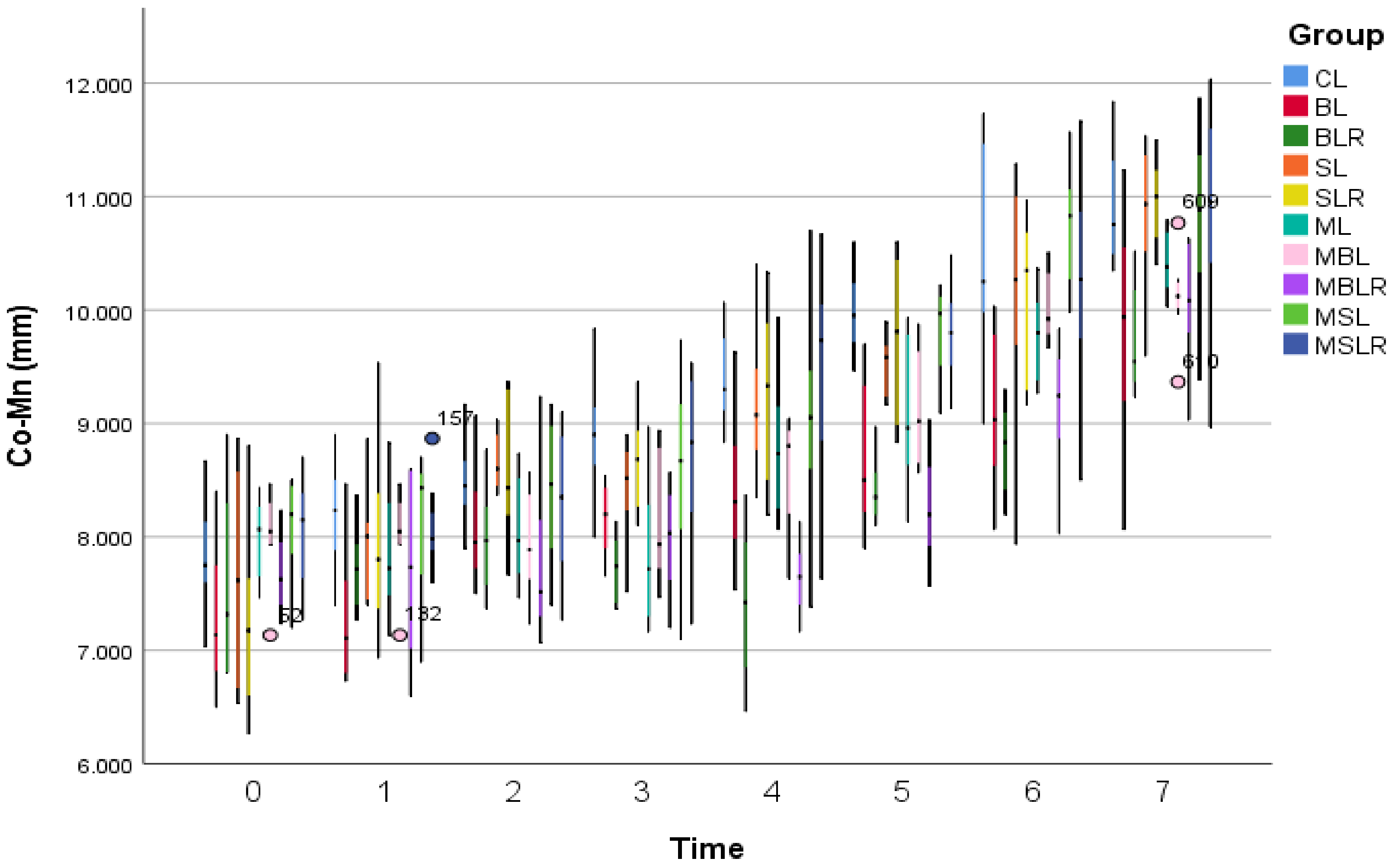


Figure 45: Boxplot of Co↔Mn (mm) for LC-LT Groups from T0 to T7

5.2.2.8 LC-LT Horizontal Projection of Upper incisors (xUii)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for xUii are displayed below (Table XXX). A line graph of the group means and a boxplot of xUii are displayed below in Figures 46 and 47. At T0 and T1 there were no significant differences in the horizontal projection of xUii between the groups. At T2 the ML, MLS, and MSLR groups had significantly shortened xUii than the CL, BL, BLR, SL, and SLR groups ($p \le 0.01$). At T3 the ML group had significantly shortened xUii than the CL and SLR groups ($p \le 0.01$). At T3 the MSLR groups had significantly shortened xUii than the CL, BL, BLR, SL, and SLR groups ($p \le 0.01$). There were no other significant differences from T4 to T7.

Table XXX: Multiple Comparisons Within Groups LC-LT for xUii

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \le 0.01$ or $p \le 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.86	0.28	0.27	-2.32	0.59	ML	0	1	0.56	0.28	0.88	-0.93	2.05
		2	-1.63*	0.21	0.00	-2.63	-0.63			2	0.21	0.24	1.00	-1.00	1.41
		3	-1.83*	0.28	0.00	-3.33	-0.34			3	-0.14	0.26	1.00	-1.47	1.20
		4	-2.48*	0.45	0.01	-5.08	0.13			4	-1.08	0.30	0.16	-2.74	0.58
		5	-2.32*	0.36	0.00	-4.35	-0.30			5	-2.40*	0.35	0.00	-4.36	-0.44
		6	-4.37*	0.26	0.00	-5.68	-3.07			6	-4.01*	0.48	0.00	-6.91	-1.12
		7	-5.04*	0.33	0.00	-6.82	-3.27			7	-4.68*	0.27	0.00	-6.15	-3.22
	1	2	-0.77	0.30	0.50	-2.24	0.70		1	2	-0.36	0.33	1.00	-1.91	1.19
		3	-0.97	0.36	0.38	-2.64	0.70			3	-0.70	0.34	0.82	-2.30	0.90
		4	-1.61	0.50	0.19	-4.10	0.88			4	-1.64	0.38	0.02	-3.41	0.14
		5	-1.46	0.42	0.11	-3.48	0.57			5	-2.96*	0.41	0.00	-4.94	-0.99
		6	-3.51*	0.34	0.00	-5.09	-1.94			6	-4.57*	0.53	0.00	-7.31	-1.84
		7	-4.18*	0.39	0.00	-6.03	-2.34			7	-5.24*	0.36	0.00	-6.91	-3.58
	2	3	-0.20	0.31	1.00	-1.70	1.30		2	3	-0.34	0.31	1.00	-1.79	1.10
		4	-0.84	0.46	0.95	-3.38	1.69			4	-1.28	0.35	0.08	-2.96	0.39
		5	-0.69	0.38	0.95	-2.67	1.29			5	-2.60*	0.39	0.00	-4.52	-0.70
		6	-2.74*	0.28	0.00	-4.09	-1.40			6	-4.22	0.51	0.00	-6.98	-1.46
		7	-3.41*	0.34	0.00	-5.16	-1.66			7	-4.89*	0.32	0.00	-6.42	-3.36
	3	4	-0.64	0.50	1.00	-3.13	1.85		3	4	-0.94	0.36	0.47	-2.65	0.78
		5	-0.49	0.43	1.00	-2.52	1.55			5	-2.26*	0.40	0.00	-4.20	-0.33
		6	-2.54*	0.34	0.00	-4.14	-0.94			6	-3.87*	0.52	0.00	-6.62	-1.14

		7	-3.21*	0.39	0.00	-5.07	-1.35			7	-4.51*	0.34	0.00	-6.13	-2.96
	4	5	0.15	0.55	1.00	-2.44	2.75		4	5	-1.33	0.43	0.21	-3.36	0.70
		6	-1.90	0.48	0.07	-4.39	0.59			6	-2.93*	0.55	0.01	-5.67	-0.20
		7	-2.56*	0.52	0.01	-5.10	-0.04			7	-3.60*	0.38	0.00	-5.37	-1.84
	5	6	-2.05*	0.41	0.01	-4.05	-0.06		5	6	-1.61	0.57	0.35	-4.38	1.16
		7	-2.72*	0.45	0.00	-4.85	-0.59			7	-2.28*	0.41	0.00	-4.25	-0.32
	6	7	-0.67	0.38	0.95	-2.46	1.13		6	7	-0.67	0.53	1.00	-3.40	2.06
BL	0	1	-0.51	0.39	1.00	-2.46	1.45	MBL	0	1	0.00	0.17	1.00	-0.79	0.79
		2	-1.24	0.35	0.11	-2.98	0.49			2	-0.34	0.21	0.98	-1.35	0.67
		3	-1.60*	0.32	0.01	-3.12	-0.08			3	-0.31	0.26	1.00	-1.66	1.04
		4	-2.08	0.43	0.02	-4.34	0.18			4	-2.00*	0.33	0.01	-3.81	-0.20
		5	-2.26	0.57	0.09	-5.42	0.90			5	-2.55*	0.37	0.00	-4.66	-0.45
		6	-3.83*	0.58	0.00	-7.12	-0.56			6	-4.10*	0.24	0.00	-5.34	-2.86
		7	-5.00*	0.38	0.00	-6.92	-3.10			7	-4.18*	0.28	0.00	-5.66	-2.72
	1	2	-0.74	0.45	0.97	-2.84	1.37		1	2	-0.34	0.21	0.98	-1.35	0.67
		3	-1.09	0.42	0.47	-3.10	0.92			3	-0.31	0.26	1.00	-1.66	1.04
		4	-1.57	0.51	0.21	-3.99	0.84			4	-2.00*	0.33	0.01	-3.81	-0.20
		5	-1.75	0.63	0.37	-4.85	1.35			5	-2.55*	0.37	0.00	-4.66	-0.45
		6	-3.33*	0.64	0.01	-6.53	-0.13			6	-4.10*	0.24	0.00	-5.34	-2.86
		7	-4.50*	0.47	0.00	-6.70	-2.30			7	-4.18*	0.28	0.00	-5.66	-2.72
	2	3	-0.36	0.39	1.00	-2.19	1.47		2	3	0.03	0.29	1.00	-1.36	1.42
		4	-0.84	0.49	0.96	-3.17	1.49			4	-1.67	0.35	0.02	-3.43	0.10
		5	-1.02	0.61	0.97	-4.10	2.07			5	-2.21*	0.39	0.01	-4.26	-0.17
		6	-2.60	0.62	0.05	-5.79	0.60			6	-3.76*	0.27	0.00	-5.06	-2.47
		7	-3.76*	0.44	0.00	-5.84	-1.69			7	-3.84*	0.30	0.00	-5.33	-2.37
	3	4	-0.48	0.46	1.00	-2.76	1.79		3	4	-1.69	0.38	0.02	-3.52	0.13
		5	-0.66	0.59	1.00	-3.76	2.44			5	-2.24*	0.42	0.01	-4.30	-0.19
		6	-2.24	0.60	0.11	-5.45	0.98			6	-3.79*	0.32	0.00	-5.27	-2.32
		7	-3.40*	0.41	0.00	-5.39	-1.43			7	-3.87*	0.34	0.00	-5.48	-2.27
	4	5	-0.18	0.66	1.00	-3.34	2.98		4	5	-0.55	0.46	1.00	-2.73	1.63
		6	-1.76	0.67	0.46	-5.01	1.49			6	-2.09*	0.37	0.00	-3.89	-0.30
		7	-2.92*	0.51	0.00	-5.32	-0.53			7	-2.18*	0.39	0.00	-4.05	-0.32
	5	6	-1.58	0.76	0.81	-5.15	1.99		5	6	-1.55	0.41	0.08	-3.59	0.50
		7	-2.75	0.62	0.03	-5.84	0.35			7	-1.63	0.43	0.07	-3.71	0.45
	6	7	-1.17	0.64	0.94	-4.37	2.03		6	7	-0.09	0.33	1.00	-1.64	1.47
		1	-0.90	0.33	0.39	-2.45	0.66			1	-0.23	0.27	1.00	-1.69	1.23

BLR	0	2	-1.82*	0.32	0.00	-3.34	-0.31	MBLR	0	2	-0.66	0.30	0.74	-2.12	0.80
		3	-1.82*	0.32	0.00	-3.34	-0.31			3	-0.95	0.31	0.24	-2.44	0.54
		4	-2.22*	0.35	0.00	-3.84	-0.61			4	-1.40	0.32	0.02	-2.91	0.12
		5	-2.58*	0.36	0.00	-4.28	-0.89			5	-2.20*	0.41	0.00	-4.15	-0.26
		6	-3.90*	0.42	0.00	-5.93	-1.88			6	-3.58*	0.32	0.00	-5.11	-2.06
		7	-4.91*	0.34	0.00	-6.49	-3.33			7	-4.25*	0.41	0.00	-6.23	-2.28
	1	2	-0.93	0.31	0.25	-2.38	0.53		1	2	-0.43	0.20	0.77	-1.41	0.55
		3	-0.93	0.31	0.25	-2.38	0.53			3	-0.71	0.22	0.18	-1.81	0.38
		4	-1.33	0.34	0.04	-2.90	0.24			4	-1.16	0.23	0.01	-2.34	0.02
		5	-1.69*	0.35	0.01	-3.35	-0.03			5	-1.97*	0.34	0.01	-3.92	-0.03
		6	-3.01*	0.41	0.00	-5.02	-1.00			6	-3.35*	0.23	0.00	-4.55	-2.15
		7	-4.01*	0.33	0.00	-5.55	-2.48			7	-4.01*	0.35	0.00	-6.01	-2.03
	2	3	0.00	0.30	1.00	-1.41	1.41		2	3	-0.28	0.25	1.00	-1.47	0.90
		4	-0.40	0.33	1.00	-1.94	1.13			4	-0.73	0.26	0.35	-1.97	0.51
		5	-0.77	0.34	0.71	-2.39	0.86			5	-1.54	0.36	0.04	-3.43	0.34
		6	-2.08*	0.40	0.01	-4.08	-0.09			6	-2.92*	0.27	0.00	-4.18	-1.66
		7	-3.09*	0.32	0.00	-4.58	-1.60			7	-3.58*	0.37	0.00	-5.51	-1.67
	3	4	-0.40	0.33	1.00	-1.94	1.13		3	4	-0.45	0.28	0.98	-1.75	0.85
		5	-0.77	0.34	0.71	-2.39	0.86			5	-1.26	0.37	0.16	-3.14	0.62
		6	-2.08*	0.40	0.01	-4.08	-0.09			6	-2.63*	0.28	0.00	-3.95	-1.33
		7	-3.09*	0.32	0.00	-4.58	-1.60			7	-3.30*	0.38	0.00	-5.23	-1.38
	4	5	-0.36	0.37	1.00	-2.07	1.35		4	5	-0.81	0.38	0.80	-2.70	1.08
		6	-1.68	0.42	0.04	-3.71	0.35			6	-2.18*	0.29	0.00	-3.54	-0.84
		7	-2.68*	0.34	0.00	-4.28	-1.09			7	-2.85*	0.39	0.00	-4.78	-0.93
	5	6	-1.32	0.44	0.23	-3.39	0.75		5	6	-1.38	0.38	0.10	-3.27	0.51
		7	-2.32*	0.36	0.00	-4.01	-0.64			7	-2.05	0.46	0.02	-4.21	0.11
	6	7	-1.00	0.42	0.60	-3.02	1.01		6	7	-0.67	0.39	0.96	-2.60	1.26
SL	0	1	-1.17	0.50	0.63	-3.51	1.17	MSL	0	1	0.55	0.42	1.00	-1.42	2.51
		2	-2.05*	0.38	0.01	-4.08	-0.02			2	0.05	0.36	1.00	-1.67	1.77
		3	-2.20*	0.41	0.01	-4.23	-0.18			3	-0.37	0.42	1.00	-2.35	1.61
		4	-3.10*	0.44	0.00	-5.18	-1.02			4	-1.77	0.55	0.20	-4.52	0.98
		5	-3.46*	0.42	0.00	-5.51	-1.42			5	-2.96*	0.41	0.00	-4.88	-1.04
		6	-4.03*	0.40	0.00	-6.05	-2.03			6	-4.36*	0.33	0.00	-6.05	-2.69
		7	-5.70*	0.43	0.00	-7.76	-3.66			7	-4.49*	0.36	0.00	-6.22	-2.78
	1	2	-0.88	0.39	0.77	-3.01	1.25		1	2	-0.50	0.37	1.00	-2.30	1.30
		3	-1.04	0.43	0.60	-3.14	1.07			3	-0.91	0.43	0.79	-2.94	1.11

		4	-1.93	0.45	0.02	-4.09	0.22			4	-2.32	0.56	0.04	-5.08	0.45
		5	-2.29*	0.44	0.01	-4.42	-0.17			5	-3.50*	0.42	0.00	-5.48	-1.53
		6	-2.86*	0.41	0.00	-4.97	-0.77			6	-4.91*	0.35	0.00	-6.69	-3.14
		7	-4.53*	0.44	0.00	-6.67	-2.41			7	-5.04*	0.37	0.00	-6.84	-3.25
	2	3	-0.16	0.27	1.00	-1.48	1.17		2	3	-0.42	0.37	1.00	-2.23	1.40
		4	-1.05	0.31	0.15	-2.60	0.50			4	-1.82	0.52	0.15	-4.59	0.95
		5	-1.41*	0.29	0.01	-2.83	0.00			5	-3.00*	0.36	0.00	-4.74	-1.27
		6	-1.98*	0.25	0.00	-3.17	-0.80			6	-4.41*	0.27	0.00	-5.69	-3.14
		7	-3.65*	0.29	0.00	-5.11	-2.21			7	-4.54*	0.30	0.00	-5.94	-3.16
	3	4	-0.90	0.35	0.48	-2.54	0.75		3	4	-1.40	0.56	0.56	-4.17	1.36
		5	-1.26	0.33	0.05	-2.81	0.29			5	-2.59*	0.43	0.00	-4.58	-0.60
		6	-1.83*	0.30	0.00	-3.24	-0.43			6	-4.00*	0.35	0.00	-5.80	-2.20
		7	-3.50*	0.34	0.00	-5.08	-1.93			7	-4.13*	0.37	0.00	-5.95	-2.31
	4	5	-0.36	0.36	1.00	-2.05	1.33		4	5	-1.19	0.56	0.79	-3.94	1.56
		6	-0.94	0.33	0.34	-2.53	0.65			6	-2.60	0.50	0.02	-5.42	0.22
		7	-2.60*	0.37	0.00	-4.32	-0.90			7	-2.73*	0.52	0.01	-5.50	0.04
	5	6	-0.57	0.31	0.93	-2.05	0.91		5	6	-1.41	0.34	0.04	-3.11	0.29
		7	-2.24*	0.35	0.00	-3.87	-0.62			7	-1.54	0.36	0.03	-3.28	0.20
	6	7	-1.66*	0.32	0.00	-3.18	-0.16		6	7	-0.13	0.27	1.00	-1.40	1.14
SLR	0	1	-1.49	0.49	0.23	-3.81	0.82	MSLR	0	1	0.20	0.39	1.00	-1.75	2.15
		2	-2.47*	0.37	0.00	-4.33	-0.62			2	0.17	0.31	1.00	-1.31	1.65
		3	-2.64*	0.37	0.00	-4.50	-0.79			3	0.01	0.23	1.00	-1.10	1.13
		4	-3.20	0.35	0.00	-5.07	-1.33			4	-1.45*	0.31	0.01	-2.91	0.02
		5	-3.92*	0.38	0.00	-5.79	-2.06			5	-2.47*	0.46	0.01	-4.94	0.00
		6	-4.59*	0.35	0.00	-6.47	-2.72			6	-3.90*	0.46	0.00	-6.35	-1.46
		7	-6.40*	0.34	0.00	-8.30	-4.52			7	-4.55*	0.28	0.00	-5.88	-3.23
	1	2	-0.99	0.42	0.69	-3.17	1.19		1	2	-0.03	0.42	1.00	-2.02	1.97
		3	-1.15	0.42	0.43	-3.34	1.03			3	-0.18	0.36	1.00	-2.17	1.81
		4	-1.71	0.40	0.06	-3.94	0.51			4	-1.64	0.41	0.05	-3.63	0.35
		5	-2.43*	0.43	0.00	-4.61	-0.25			5	-2.66*	0.54	0.01	-5.23	-0.11
		6	-3.10*	0.40	0.00	-5.33	-0.87			6	-4.10*	0.54	0.00	-6.64	-1.57
		7	-4.91*	0.39	0.00	-7.17	-2.66			7	-4.75*	0.39	0.00	-6.71	-2.80
	2	3	-0.17	0.27	1.00	-1.43	1.09		2	3	-0.16	0.28	1.00	-1.59	1.28
		4	-0.73	0.24	0.25	-1.89	0.43			4	-1.61*	0.35	0.01	-3.23	0.00
		5	-1.44*	0.28	0.00	-2.77	-0.13			5	-2.64*	0.49	0.01	-5.10	-0.19
		6	-2.11*	0.24	0.00	-3.27	-0.96			6	-4.07*	0.48	0.00	-6.51	-1.65

		7	-3.92	0.23	0.00	-5.07	-2.79			7	-4.72*	0.32	0.00	-6.24	-3.20
	3	4	-0.56	0.23	0.61	-1.67	0.56		3	4	-1.45*	0.27	0.01	-2.87	-0.05
		5	-1.28*	0.28	0.01	-2.57	0.02			5	-2.49	0.44	0.01	-5.04	0.07
		6	-1.94*	0.23	0.00	-3.06	-0.84			6	-3.92*	0.44	0.00	-6.45	-1.39
		7	-3.76*	0.22	0.00	-4.85	-2.67			7	-4.56*	0.24	0.00	-5.78	-3.35
	4	5	-0.72	0.25	0.30	-1.92	0.48		4	5	-1.03	0.49	0.82	-3.48	1.43
		6	-1.38*	0.20	0.00	-2.31	-0.47			6	-2.46*	0.48	0.01	-4.89	-0.03
		7	-3.20	0.19	0.00	-4.08	-2.32			7	-3.10*	0.32	0.00	-4.61	-1.60
	5	6	-0.67	0.25	0.40	-1.87	0.53		5	6	-1.44	0.59	0.57	-4.21	1.34
		7	-2.48*	0.24	0.00	-3.67	-1.29			7	-2.08	0.47	0.03	-4.54	0.38
	6	7	-1.81*	0.18	0.00	-2.68	-0.95		6	7	-0.65	0.47	1.00	-3.08	1.79

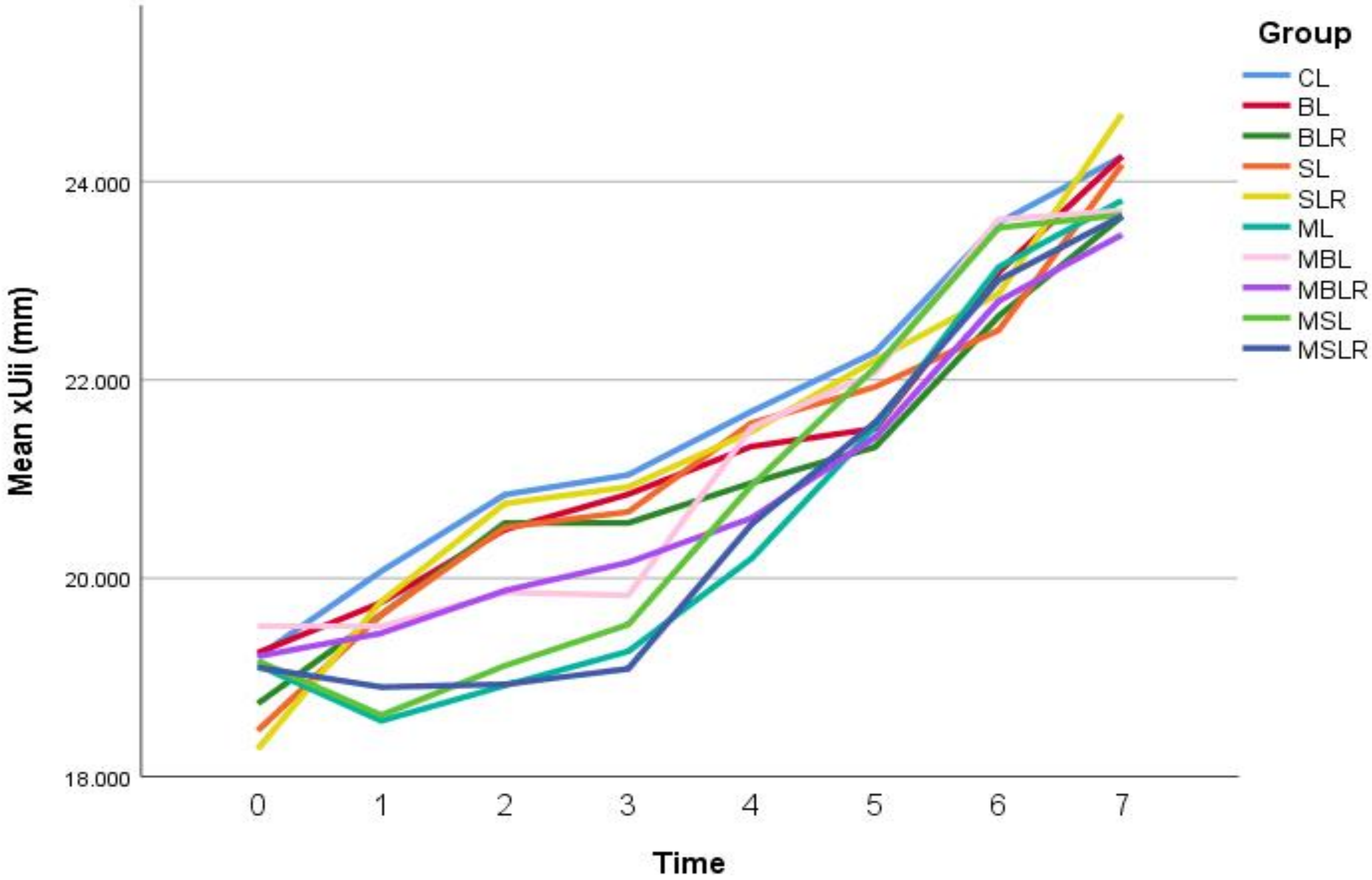


Figure 46: Line Graph of mean xUii (mm) for LC-LT Groups from T0 to T7

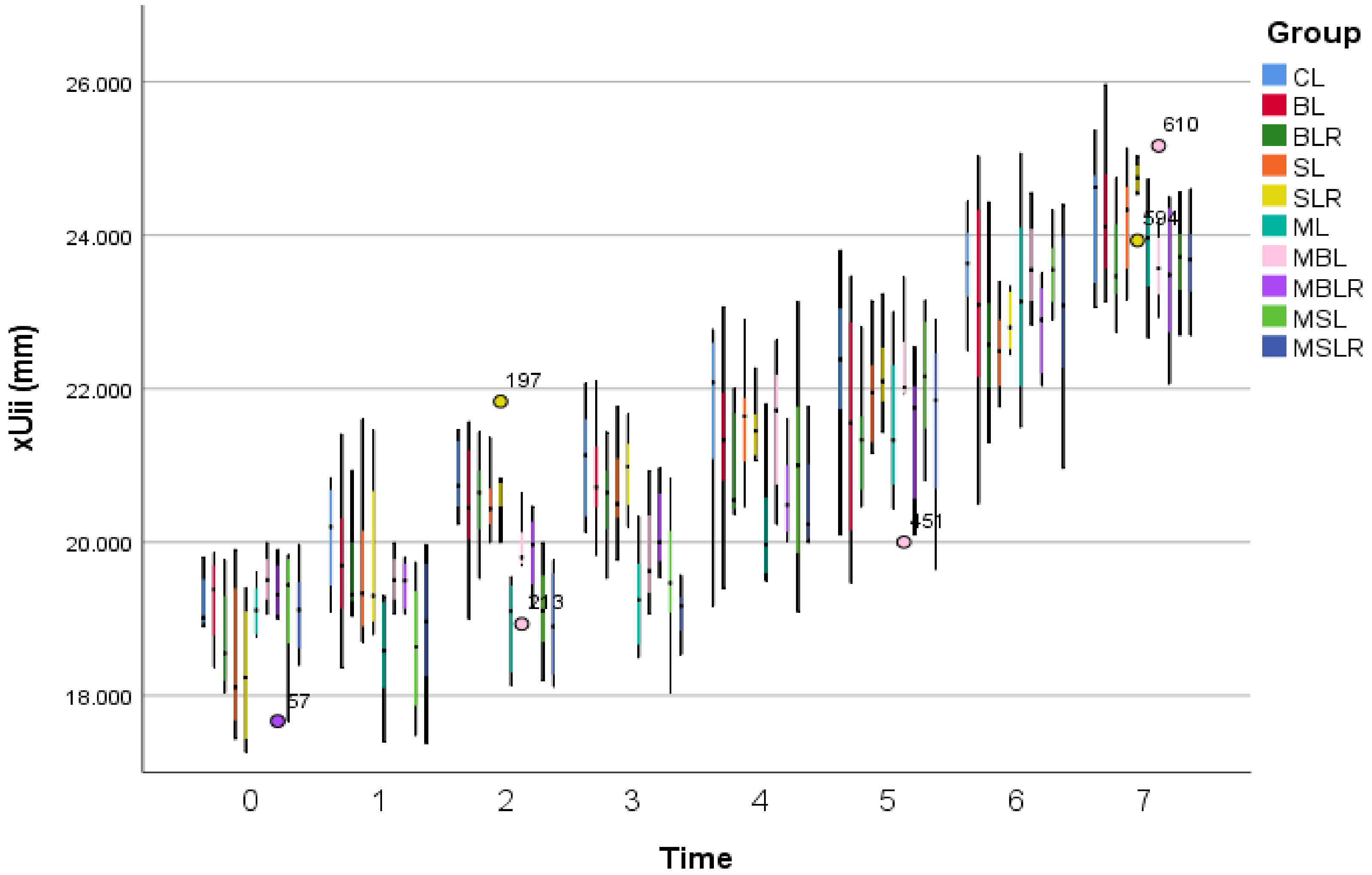


Figure 47: Boxplot of xUii (mm) for LC-LT Groups from T0 to T7

5.2.2.9 LC-LT Horizontal Projection of Lower incisors (xLis)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for xLis are displayed below (Table XXXI). A line graph of the group means and a boxplot of xLis are displayed below in Figures 48 and 49. At T2 the MBLR group had a significantly reduced xLis measurement than BL, SL, and SLR groups ($p \leq 0.01$). The MSLR group had a significantly reduced xLis compared with the SL and SLR groups ($p \leq 0.01$). At T5 the MBL and MBLR groups had an increased xLis length than the BLR group ($p \leq 0.001$). At T6 the MBLR group had a greater xLis length than the SL group ($p \leq 0.01$). At T7 the MBL and MBLR groups finished with longer xLis measurements than all of the other groups however this was not statistically significant.

Table XXXI: Within Comparisons LC-LT for xLis

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.66	0.24	0.40	-1.85	0.53	ML	0	1	-0.17	0.46	1.00	-2.32	1.99
		2	-0.69	0.37	0.94	-2.75	1.37			2	-0.36	0.37	1.00	-2.14	1.41
		3	-0.93	0.36	0.60	-2.98	1.12			3	-0.24	0.38	1.00	-2.04	1.56
		4	-1.80*	0.32	0.01	-3.52	-0.10			4	-0.91	0.46	0.85	-3.06	1.23
		5	-2.41*	0.41	0.01	-4.78	-0.04			5	-2.05*	0.41	0.01	-3.98	-0.13
		6	-3.26*	0.25	0.00	-4.57	-1.97			6	-3.49*	0.44	0.00	-5.57	-1.41
		7	-4.02*	0.33	0.00	-5.83	-2.21			7	-4.56*	0.47	0.00	-6.76	-2.37
	1	2	-0.03	0.40	1.00	-2.04	1.98		1	2	-0.19	0.40	1.00	-2.21	1.82
		3	-0.27	0.40	1.00	-2.27	1.73			3	-0.08	0.41	1.00	-2.10	1.95
		4	-1.15	0.35	0.17	-2.87	0.57			4	-0.74	0.49	0.99	-3.02	1.54
		5	-1.75	0.44	0.07	-4.04	0.53			5	-1.89	0.44	0.03	-3.99	0.22
		6	-2.61*	0.30	0.00	-4.03	-1.20			6	-3.32*	0.48	0.00	-5.55	-1.09
		7	-3.36*	0.37	0.00	-5.16	-1.56			7	-4.39*	0.50	0.00	-6.72	-2.08
	2	3	-0.24	0.49	1.00	-2.52	2.03		2	3	0.12	0.31	1.00	-1.33	1.57
		4	-1.12	0.45	0.53	-3.25	1.00			4	-0.55	0.40	1.00	-2.56	1.46
		5	-1.73	0.52	0.14	-4.18	0.73			5	-1.69*	0.35	0.01	-3.36	-0.02
		6	-2.58*	0.41	0.00	-4.60	-0.56			6	-3.12*	0.39	0.00	-5.04	-1.21
		7	-3.33*	0.46	0.00	-5.50	-1.17			7	-4.20*	0.41	0.00	-6.27	-2.13
	3	4	-0.88	0.45	0.87	-3.00	1.24		3	4	-0.67	0.41	0.98	-2.69	1.35
		5	-1.48	0.52	0.31	-3.93	0.96			5	-1.81*	0.36	0.01	-3.52	-0.11
		6	-2.34*	0.41	0.00	-4.35	-0.33			6	-3.24*	0.40	0.00	-5.18	-1.31

		7	-3.09*	0.46	0.00	-5.25	-0.93			7	-4.32*	0.42	0.00	-6.40	-2.24
	4	5	-0.60	0.49	1.00	-2.94	1.73		4	5	-1.14	0.44	0.47	-3.24	0.96
		6	-1.46	0.37	0.04	-3.21	0.28			6	-2.57*	0.48	0.00	-4.80	-0.36
		7	-2.21*	0.42	0.00	-4.19	-0.24			7	-3.65*	0.49	0.00	-5.97	-1.34
	5	6	-0.86	0.45	0.91	-3.14	1.42		5	6	-1.44	0.43	0.13	-3.46	0.59
		7	-1.61	0.50	0.17	-3.97	0.76			7	-2.51*	0.45	0.00	-4.66	-0.36
	6	7	-0.75	0.38	0.87	-2.57	1.07		6	7	-1.08	0.48	0.71	-3.34	1.19
BL	0	1	-0.93	0.39	0.63	-2.87	1.01	MBL	0	1	0.00	0.44	1.00	-2.05	2.05
		2	-1.33	0.40	0.15	-3.28	0.62			2	-1.10	0.43	0.47	-3.09	0.90
		3	-0.91	0.46	0.86	-3.08	1.25			3	-0.83	0.36	0.68	-2.64	0.97
		4	-1.82	0.50	0.08	-4.18	0.55			4	-2.60*	0.36	0.00	-4.41	-0.80
		5	-2.05	0.64	0.20	-5.24	1.14			5	-3.60*	0.39	0.00	-5.47	-1.73
		6	-3.49	0.74	0.02	-7.33	0.35			6	-4.60*	0.32	0.00	-6.48	-2.74
		7	-4.73*	0.42	0.00	-6.75	-2.73			7	-5.21*	0.34	0.00	-7.04	-3.40
	1	2	-0.40	0.29	1.00	-1.77	0.97		1	2	-1.10	0.43	0.47	-3.09	0.90
		3	0.01	0.38	1.00	-1.86	1.89			3	-0.83	0.36	0.68	-2.64	0.97
		4	-0.89	0.43	0.84	-3.09	1.31			4	-2.60*	0.36	0.00	-4.41	-0.80
		5	-1.12	0.58	0.92	-4.39	2.14			5	-3.60*	0.39	0.00	-5.47	-1.73
		6	-2.56	0.69	0.14	-6.55	1.43			6	-4.60*	0.32	0.00	-6.48	-2.74
		7	-3.80*	0.33	0.00	-5.38	-2.24			7	-5.21*	0.34	0.00	-7.04	-3.40
	2	3	0.41	0.39	1.00	-1.48	2.31		2	3	0.26	0.34	1.00	-1.44	1.96
		4	-0.49	0.44	1.00	-2.69	1.71			4	-1.51	0.35	0.03	-3.22	0.19
		5	-0.72	0.59	1.00	-3.96	2.52			5	-2.50*	0.38	0.00	-4.30	-0.72
		6	-2.16	0.69	0.31	-6.12	1.80			6	-3.51*	0.31	0.00	-5.27	-1.76
		7	-3.40*	0.34	0.00	-5.01	-1.81			7	-4.12*	0.32	0.00	-5.83	-2.42
	3	4	-0.90	0.50	0.93	-3.24	1.43		3	4	-1.77*	0.26	0.00	-3.00	-0.55
		5	-1.14	0.63	0.95	-4.32	2.05			5	-2.76*	0.30	0.00	-4.21	-1.32
		6	-2.58	0.73	0.14	-6.42	1.27			6	-3.77*	0.20	0.00	-4.82	-2.73
		7	-3.82*	0.41	0.00	-5.79	-1.86			7	-4.38*	0.23	0.00	-5.46	-3.31
	4	5	-0.23	0.67	1.00	-3.46	2.99		4	5	-0.99	0.31	0.16	-2.45	0.47
		6	-1.67	0.76	0.76	-5.50	2.16			6	-1.99*	0.21	0.00	-3.10	-0.90
		7	-2.91*	0.46	0.00	-5.15	-0.69			7	-2.60*	0.23	0.00	-3.73	-1.49
	5	6	-1.44	0.86	0.97	-5.48	2.60		5	6	-1.00*	0.26	0.10	-2.44	0.43
		7	-2.69	0.61	0.04	-5.88	0.51			7	-1.61*	0.28	0.00	-3.02	-0.21
	6	7	-1.25	0.71	0.96	-5.14	2.65		6	7	-0.61	0.17	0.08	-1.41	0.19
		1	-0.87	0.32	0.48	-2.58	0.84			1	0.33	0.39	1.00	-1.68	2.34

BLR	0	2	-1.19	0.37	0.26	-3.24	0.86	MBLR	0	2	1.18	0.28	0.02	-0.11	2.48
		3	-1.19	0.37	0.26	-3.24	0.86			3	-0.34	0.26	1.00	-1.54	0.86
		4	-1.37*	0.26	0.01	-2.69	-0.06			4	-1.28	0.29	0.02	-2.65	0.09
		5	-1.50*	0.28	0.01	-2.90	-0.12			5	-2.95*	0.25	0.00	-4.14	-1.77
		6	-2.90*	0.46	0.01	-5.54	-0.26			6	-4.22*	0.22	0.00	-5.31	-3.13
		7	-4.46*	0.35	0.00	-6.38	-2.55			7	-4.61*	0.27	0.00	-5.86	-3.37
	1	2	-0.32	0.45	1.00	-2.45	1.82		1	2	0.86	0.40	0.80	-1.15	2.87
		3	-0.32	0.45	1.00	-2.45	1.82			3	-0.67	0.39	0.97	-2.68	1.34
		4	-0.50	0.37	1.00	-2.26	1.26			4	-1.61	0.41	0.06	-3.63	0.41
		5	-0.64	0.38	0.97	-2.42	1.15			5	-3.28*	0.38	0.00	-5.30	-1.27
		6	-2.03	0.53	0.06	-4.60	0.54			6	-4.5*	0.36	0.00	-6.63	-2.47
		7	-3.59*	0.44	0.00	-5.65	-1.54			7	-4.94*	0.39	0.00	-6.95	-2.94
	2	3	0.00	0.49	1.00	-2.29	2.29		2	3	-1.52*	0.27	0.00	-2.78	-0.27
		4	-0.18	0.41	1.00	-2.21	1.84			4	-2.46*	0.30	0.00	-3.87	-1.06
		5	-0.32	0.42	1.00	-2.36	1.72			5	-4.13*	0.26	0.00	-5.38	-2.90
		6	-1.71	0.56	0.22	-4.36	0.93			6	-5.40*	0.23	0.00	-6.58	-4.23
		7	-3.27*	0.48	0.00	-5.50	-1.05			7	-5.80*	0.28	0.00	-7.10	-4.50
	3	4	-0.18	0.41	1.00	-2.21	1.84		3	4	-0.94	0.28	0.14	-2.28	0.40
		5	-0.32	0.42	1.00	-2.36	1.72			5	-2.61*	0.24	0.00	-3.75	-1.48
		6	-1.71	0.56	0.22	-4.36	0.93			6	-3.88*	0.21	0.00	-4.90	-2.86
		7	-3.27*	0.48	0.00	-5.50	-1.05			7	-4.27*	0.26	0.00	-5.48	-3.07
	4	5	-0.14	0.33	1.00	-1.67	1.40		4	5	-1.67*	0.28	0.00	-3.00	-0.35
		6	-1.53	0.49	0.26	-4.08	1.02			6	-2.94*	0.25	0.00	-4.23	-1.65
		7	-3.09*	0.40	0.00	-5.01	-1.17			7	-3.33*	0.29	0.00	-4.71	-1.97
	5	6	-1.40	0.50	0.39	-3.94	1.15		5	6	-1.26*	0.20	0.00	-2.26	-0.28
		7	-2.95*	0.40	0.00	-4.90	-1.02			7	-1.66*	0.25	0.00	-2.85	-0.47
	6	7	-1.56	0.55	0.31	-4.18	1.05		6	7	-0.39	0.22	0.95	-1.49	0.71
SL	0	1	-0.88	0.35	0.57	-2.63	0.88	MSL	0	1	0.15	0.39	1.00	-1.89	2.19
		2	-1.54*	0.26	0.00	-2.74	-0.35			2	0.15	0.25	1.00	-1.04	1.34
		3	-1.60*	0.30	0.00	-3.01	-0.20			3	-0.89	0.29	0.22	-2.27	0.49
		4	-2.44*	0.36	0.00	-4.25	-0.64			4	-0.91	0.33	0.40	-2.56	0.73
		5	-2.61*	0.39	0.00	-4.61	-0.62			5	-1.72	0.44	0.08	-4.04	0.60
		6	-3.32*	0.32	0.00	-4.85	-1.80			6	-3.47*	0.30	0.00	-4.93	-2.02
		7	-4.81*	0.33	0.00	-6.42	-3.21			7	-3.69*	0.25	0.00	-4.88	-2.51
	1	2	-0.67	0.35	0.91	-2.42	1.09		1	2	0.00	0.39	1.00	-2.04	2.04
		3	-0.73	0.38	0.90	-2.54	1.09			3	-1.04	0.42	0.56	-3.09	1.01

		4	-1.57	0.43	0.07	-3.59	0.45			4	-1.06	0.45	0.62	-3.19	1.06
		5	-1.74	0.46	0.05	-3.88	0.41			5	-1.87	0.53	0.09	-4.35	0.61
		6	-2.44*	0.40	0.00	-4.32	-0.58			6	-3.62*	0.43	0.00	-5.69	-1.56
		7	-3.93*	0.41	0.00	-5.85	-2.03			7	-3.84*	0.39	0.00	-5.88	-1.81
		3	-0.06	0.29	1.00	-1.46	1.34			3	-1.04	0.29	0.09	-2.42	0.33
		4	-0.90	0.36	0.55	-2.71	0.90			4	-1.07	0.33	0.20	-2.71	0.58
	2	5	-1.07	0.39	0.42	-3.06	0.93		2	5	-1.87	0.44	0.05	-4.20	0.45
		6	-1.78*	0.31	0.00	-3.30	-0.26			6	-3.62*	0.30	0.00	-5.08	-2.17
		7	-3.27*	0.33	0.00	-4.87	-1.67			7	-3.84*	0.25	0.00	-5.03	-2.66
		4	-0.84	0.39	0.75	-2.70	1.01			4	-0.02	0.36	1.00	-1.74	1.69
	3	5	-1.01	0.41	0.59	-3.03	1.01		3	5	-0.83	0.46	0.94	-3.14	1.47
		6	-1.72*	0.35	0.01	-3.35	-0.09			6	-2.58*	0.33	0.00	-4.15	-1.02
		7	-3.21*	0.36	0.00	-4.90	-1.52			7	-2.80*	0.29	0.00	-4.18	-1.43
		5	-0.17	0.46	1.00	-2.33	2.00			5	-0.81	0.49	0.97	-3.15	1.54
	4	6	-0.88	0.40	0.75	-2.78	1.03		4	6	-2.56*	0.37	0.00	-4.31	-0.81
		7	-2.36*	0.41	0.00	-4.31	-0.43			7	-2.78*	0.33	0.00	-4.43	-1.14
	5	6	-0.71	0.43	0.97	-2.76	1.34		5	6	-1.75	0.47	0.08	-4.07	0.56
		7	-2.20*	0.44	0.01	-4.28	-0.12			7	-1.97	0.44	0.03	-4.30	0.35
	6	7	-1.49	0.38	0.04	-3.25	0.27		6	7	-0.22	0.30	1.00	-1.68	1.23
		1	-1.24	0.37	0.14	-3.03	0.55			1	0.88	0.44	0.88	-1.41	3.16
		2	-1.97*	0.31	0.00	-3.42	-0.53			2	0.51	0.25	0.83	-0.68	1.69
		3	-2.00*	0.30	0.00	-3.39	-0.61			3	-0.08	0.28	1.00	-1.40	1.23
	0	4	-2.82*	0.43	0.00	-5.00	-0.65		0	4	-1.10	0.33	0.15	-2.70	0.50
		5	-3.45*	0.53	0.00	-6.32	-0.60			5	-1.60	0.37	0.03	-3.42	0.22
		6	-3.74*	0.36	0.00	-5.46	-2.02			6	-2.95*	0.35	0.00	-4.68	-1.24
		7	-5.04*	0.37	0.00	-6.82	-3.27			7	-3.82*	0.31	0.00	-5.30	-2.34
		2	-0.74	0.38	0.88	-2.54	1.07			2	-0.37	0.42	1.00	-2.71	1.97
SLR		3	-0.76	0.37	0.82	-2.54	1.02	MSLR		3	-0.96	0.44	0.78	-3.25	1.33
	1	4	-1.59	0.48	0.15	-3.87	0.69		1	4	-1.98	0.47	0.03	-4.29	0.33
		5	-2.22	0.57	0.06	-5.07	0.63			5	-2.47*	0.50	0.01	-4.85	-0.10
		6	-2.50*	0.42	0.00	-4.46	-0.55			6	-3.83*	0.49	0.00	-6.18	-1.50
		7	-3.80*	0.43	0.00	-5.80	-1.81			7	-4.69*	0.46	0.00	-6.99	-2.41
		3	-0.03	0.30	1.00	-1.44	1.39			3	-0.59	0.24	0.59	-1.76	0.58
	2	4	-0.85	0.44	0.89	-3.03	1.33		2	4	-1.60*	0.30	0.01	-3.16	-0.05
		5	-1.48	0.54	0.44	-4.34	1.37			5	-2.10*	0.34	0.00	-3.92	-0.29
		6	-1.76*	0.36	0.01	-3.50	-0.03			6	-3.46*	0.32	0.00	-5.17	-1.76

		7	-3.07*	0.37	0.00	-4.86	-1.29			7	-4.32*	0.28	0.00	-5.73	-2.92
	3	4	-0.83	0.43	0.90	-3.00	1.35		3	4	-1.02	0.33	0.22	-2.61	0.57
		5	-1.46	0.53	0.45	-4.33	1.41			5	-1.52	0.37	0.04	-3.33	0.30
		6	-1.74*	0.35	0.01	-3.45	-0.04			6	-2.87*	0.35	0.00	-4.59	-1.16
		7	-3.04*	0.36	0.00	-4.81	-1.28			7	-3.73*	0.31	0.00	-5.21	-2.27
	4	5	-0.63	0.61	1.00	-3.56	2.30		4	5	-0.50	0.41	1.00	-2.43	1.43
		6	-0.91	0.47	0.89	-3.17	1.34			6	-	0.40	0.01	-3.71	-0.01
		7	-2.22*	0.48	0.01	-4.49	0.05			7	-2.71*	0.36	0.00	-4.41	-1.03
	5	6	-0.28	0.57	1.00	-3.12	2.56		5	6	-1.36	0.43	0.17	-3.35	0.63
		7	-1.59	0.57	0.39	-4.43	1.26			7	-2.22*	0.39	0.00	-4.09	-0.35
	6	7	-1.30	0.42	0.19	-3.25	0.64		6	7	-0.86	0.38	0.68	-2.65	0.93

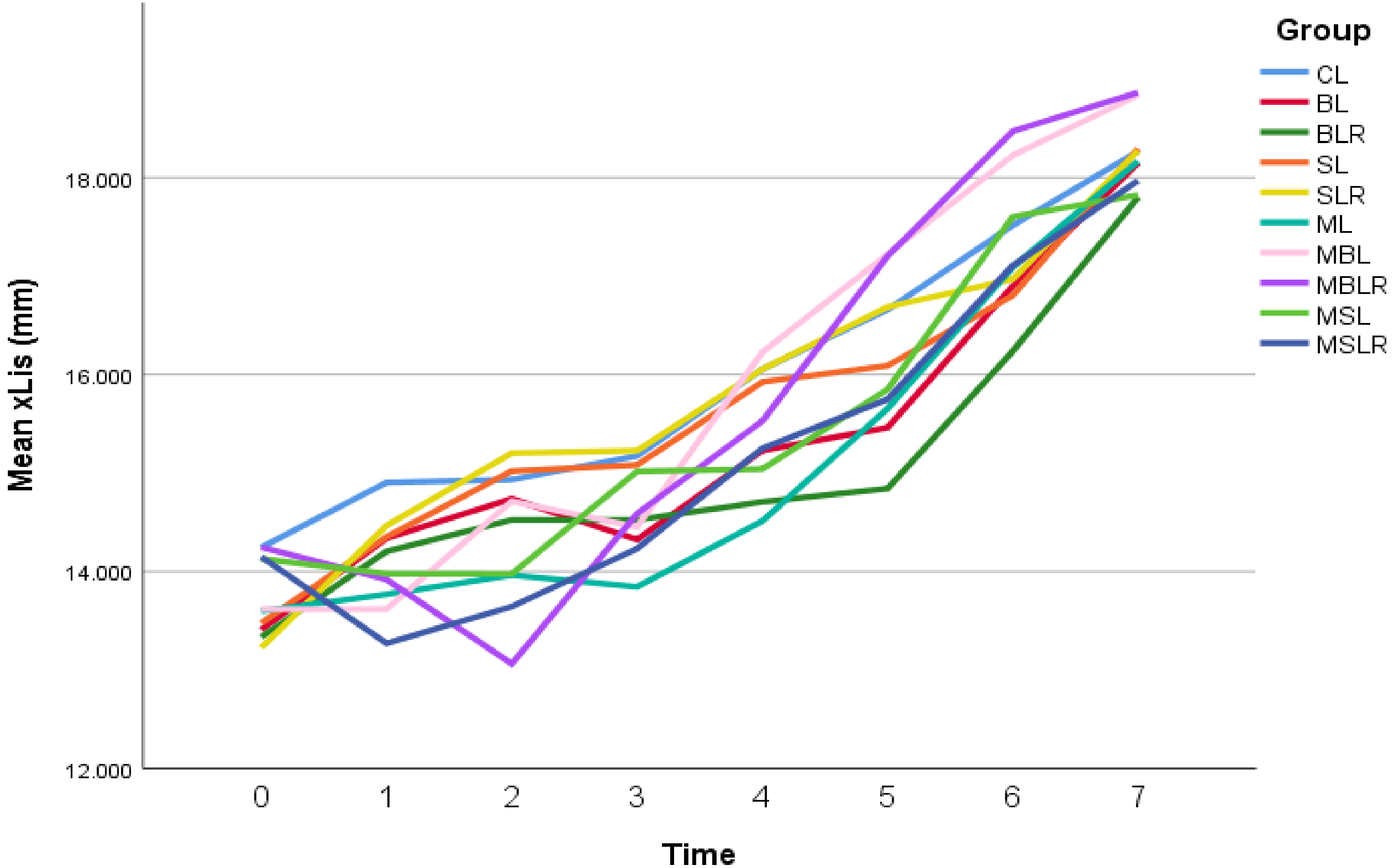


Figure 48: Line Graph of mean xLis (mm) for LC-LT groups from T0 to T7

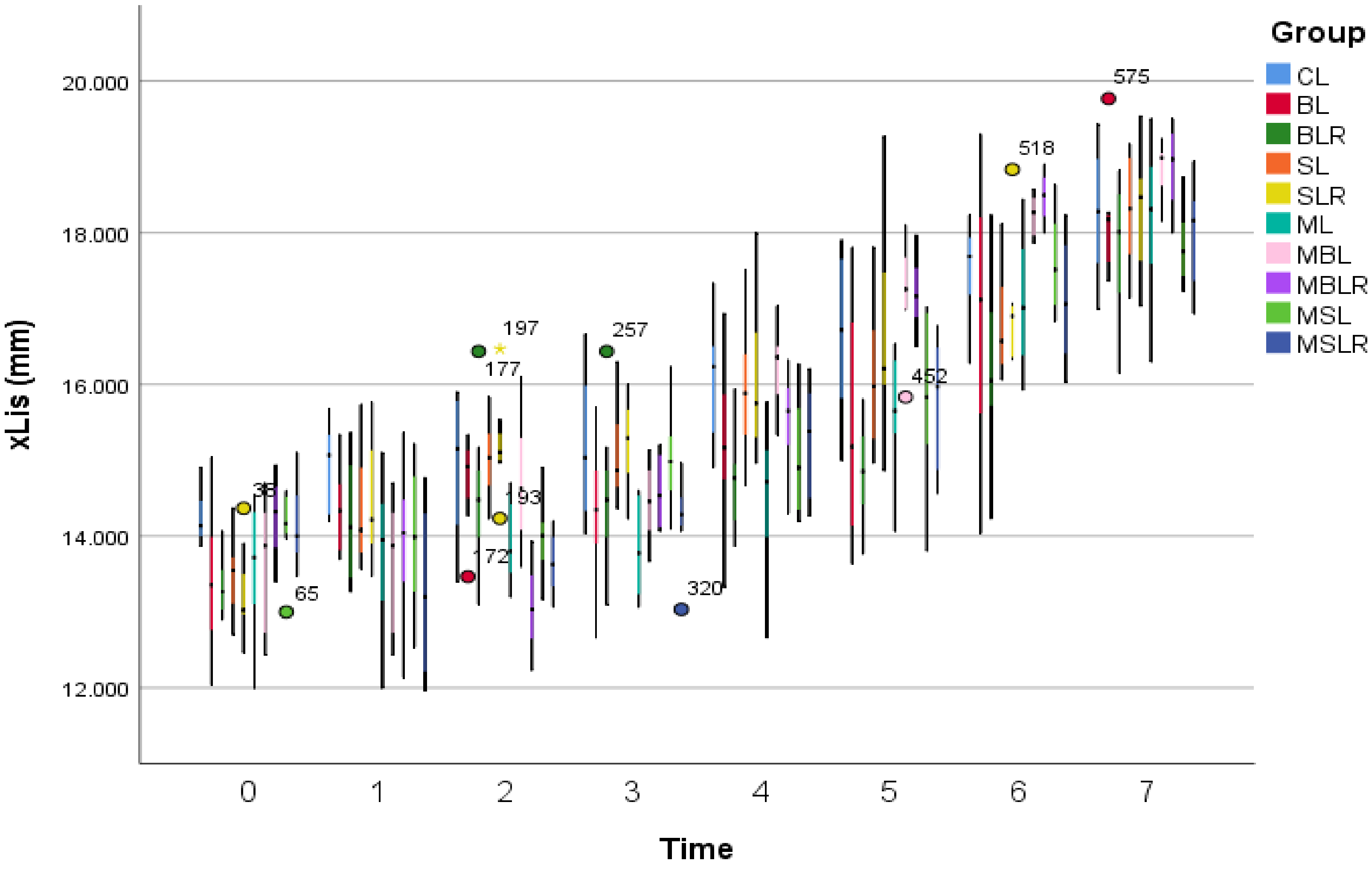


Figure 49: Boxplot of xLis (mm) for LC-LT groups from T0 to T7

5.2.2.10 LC-LT Anterior Dental Overjet (ADO1)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for ADO1 are displayed below (Table XXXII). A line graph of the group means and a boxplot of ADO1 are displayed below in Figures 50 and 51. There were no significant differences between the LT groups from T0 until T5 with respect to anterior overjet. At T6 the MBL group had a significantly reduced ADO1 compared with the CL, BL, BLR, and MSL groups ($p \leq 0.01$). The MBLR group had a significantly reduced ADO1 compared with the BLR groups ($p \leq 0.01$). At T7 the MBL group had a significantly reduced ADO1 compared with the CL and BLR groups ($p \leq 0.01$). The MBLR group had a significantly reduced ADO1 compared with the CL, BL, BLR, and MSL groups ($p \leq 0.01$). There was a large range of measurements for each group across the timepoints.

Table XXXII: Multiple Comparisons Within Groups LC-LT for ADO1

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
CL	0	1	-0.45	0.11	0.06	-1.05	0.15
		2	-0.69*	0.07	0.00	-1.07	-0.32
		3	-0.77*	0.09	0.00	-1.28	-0.27
		4	-0.65	0.14	0.04	-1.45	0.16
		5	-0.92*	0.10	0.00	-1.48	-0.36
		6	-0.98*	0.10	0.00	-1.54	-0.43
		7	-1.21*	0.10	0.00	-1.78	-0.65
	1	2	-0.25	0.12	0.83	-0.83	0.34
		3	-0.33	0.13	0.54	-0.94	0.29
		4	-0.20	0.17	1.00	-0.98	0.59
		5	-0.47	0.14	0.11	-1.12	0.17
		6	-0.54	0.14	0.04	-1.18	0.11
		7	-0.76*	0.14	0.00	-1.41	-0.12
	2	3	-0.08	0.11	1.00	-0.59	0.43
		4	0.05	0.15	1.00	-0.72	0.82
		5	-0.23	0.11	0.88	-0.78	0.33
		6	-0.29	0.11	0.50	-0.84	0.26
		7	-0.52	0.11	0.02	-1.08	0.04
	3	4	0.13	0.16	1.00	-0.64	0.90
		5	-0.15	0.13	1.00	-0.74	0.45

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
						Lower	Upper
ML	0	1	-0.72	0.27	0.57	-2.29	0.86
		2	-1.26*	0.20	0.00	-2.32	-0.21
		3	-1.12	0.25	0.05	-2.55	0.31
		4	-1.14	0.26	0.06	-2.64	0.37
		5	-1.42	0.32	0.05	-3.28	0.44
		6	-1.35*	0.21	0.00	-2.49	-0.22
		7	-1.09	0.33	0.27	-3.06	0.87
	1	2	-0.55	0.32	0.96	-2.09	0.99
		3	-0.40	0.35	1.00	-2.06	1.26
		4	-0.42	0.36	1.00	-2.11	1.27
		5	-0.71	0.40	0.95	-2.59	1.18
		6	-0.64	0.32	0.87	-2.20	0.92
		7	-0.38	0.41	1.00	-2.33	1.58
	2	3	0.15	0.30	1.00	-1.28	1.58
		4	0.13	0.31	1.00	-1.36	1.62
		5	-0.15	0.35	1.00	-1.92	1.62
		6	-0.09	0.26	1.00	-1.32	1.15
		7	0.18	0.37	1.00	-1.69	2.04
	3	4	-0.02	0.35	1.00	-1.64	1.60
		5	-0.30	0.39	1.00	-2.14	1.53

		6	-0.21	0.13	0.97	-0.80	0.38			6	-0.24	0.31	1.00	-1.69	1.21
		7	-0.44	0.13	0.10	-1.04	0.16			7	0.02	0.40	1.00	-1.89	1.94
	4	5	-0.28	0.16	0.97	-1.05	0.50		4	5	-0.29	0.39	1.00	-2.15	1.58
		6	-0.34	0.16	0.80	-1.12	0.44			6	-0.22	0.32	1.00	-1.73	1.29
		7	-0.57	0.16	0.10	-1.35	0.21			7	0.04	0.41	1.00	-1.89	1.98
	5	6	-0.06	0.13	1.00	-0.68	0.56		5	6	0.06	0.36	1.00	-1.71	1.84
		7	-0.30	0.13	0.72	-0.92	0.33			7	0.33	0.44	1.00	-1.74	2.40
	6	7	-0.23	0.13	0.96	-0.85	0.39		6	7	0.27	0.37	1.00	-1.60	2.13
BL	0	1	-0.45	0.27	0.97	-1.75	0.84	MBL	0	1	-0.50	0.39	1.00	-2.50	1.50
		2	-0.80	0.25	0.20	-2.05	0.45			2	-0.62	0.27	0.68	-1.90	0.66
		3	-1.07	0.23	0.03	-2.34	0.20			3	-0.55	0.27	0.83	-1.82	0.72
		4	-1.13	0.22	0.03	-2.48	0.21			4	-0.27	0.27	1.00	-1.52	0.99
		5	-1.09	0.26	0.03	-2.35	0.18			5	0.17	0.33	1.00	-1.38	1.73
		6	-1.24*	0.26	0.01	-2.50	0.03			6	0.12	0.25	1.00	-1.05	1.29
		7	-1.15	0.26	0.02	-2.41	0.11			7	0.21	0.29	1.00	-1.15	1.56
	1	2	-0.35	0.21	0.97	-1.34	0.64		1	2	-0.12	0.39	1.00	-2.12	1.88
		3	-0.62	0.19	0.20	-1.59	0.35			3	-0.05	0.39	1.00	-2.05	1.94
		4	-0.68	0.17	0.12	-1.71	0.35			4	0.23	0.39	1.00	-1.76	2.23
		5	-0.63	0.22	0.31	-1.68	0.41			5	0.67	0.43	0.99	-1.39	2.73
		6	-0.79	0.22	0.09	-1.83	0.26			6	0.62	0.37	0.98	-1.40	2.63
		7	-0.70	0.22	0.18	-1.74	0.34			7	0.71	0.40	0.96	-1.29	2.71
	2	3	-0.27	0.15	0.94	-0.99	0.45		2	3	0.07	0.27	1.00	-1.20	1.33
		4	-0.33	0.13	0.55	-1.06	0.39			4	0.35	0.27	1.00	-0.89	1.60
		5	-0.29	0.19	0.99	-1.19	0.62			5	0.79	0.32	0.57	-0.76	2.35
		6	-0.44	0.19	0.67	-1.34	0.47			6	0.74	0.24	0.24	-0.42	1.90
		7	-0.35	0.19	0.91	-1.24	0.53			7	0.83	0.29	0.29	-0.52	2.18
	3	4	-0.06	0.10	1.00	-0.59	0.46		3	4	0.29	0.26	1.00	-0.94	1.52
		5	-0.02	0.17	1.00	-0.88	0.85			5	0.73	0.32	0.70	-0.82	2.27
		6	-0.17	0.17	1.00	-1.03	0.70			6	0.67	0.24	0.35	-0.47	1.82
		7	-0.08	0.17	1.00	-0.92	0.76			7	0.76	0.29	0.41	-0.58	2.10
	4	5	0.05	0.15	1.00	-0.86	0.96		4	5	0.44	0.32	1.00	-1.10	1.98
		6	-0.10	0.15	1.00	-1.02	0.81			6	0.38	0.24	0.98	-0.74	1.50
		7	-0.02	0.15	1.00	-0.90	0.87			7	0.47	0.28	0.97	-0.85	1.80
	5	6	-0.15	0.21	1.00	-1.13	0.83		5	6	-0.05	0.30	1.00	-1.57	1.46
		7	-0.07	0.21	1.00	-1.03	0.90			7	0.04	0.34	1.00	-1.56	1.63
	6	7	0.09	0.21	1.00	-0.88	1.05		6	7	0.09	0.26	1.00	-1.17	1.36

BLR	0	1	-0.65*	0.10	0.00	-1.14	-0.16	MBLR	0	1	-0.32	0.31	1.00	-1.76	1.12
		2	-1.13*	0.20	0.01	-2.26	0.00			2	-1.21	0.34	0.08	-2.80	0.38
		3	-1.13*	0.20	0.01	-2.26	0.00			3	-1.10	0.26	0.03	-2.39	0.19
		4	-1.34*	0.16	0.00	-2.22	-0.47			4	-0.78	0.27	0.30	-2.08	0.52
		5	-1.58*	0.24	0.01	-3.04	-0.13			5	-0.30	0.41	1.00	-2.33	1.74
		6	-1.50*	0.15	0.00	-2.35	-0.67			6	0.14	0.29	1.00	-1.22	1.50
		7	-1.33*	0.10	0.00	-1.83	-0.84			7	0.03	0.25	1.00	-1.26	1.31
	1	2	-0.48	0.20	0.69	-1.58	0.62		1	2	-0.90	0.33	0.40	-2.47	0.68
		3	-0.48	0.20	0.69	-1.58	0.62			3	-0.79	0.25	0.22	-2.03	0.46
		4	-0.69	0.17	0.05	-1.55	0.17			4	-0.46	0.26	0.95	-1.73	0.80
		5	-0.94	0.25	0.13	-2.35	0.48			5	0.02	0.41	1.00	-2.01	2.05
		6	-0.85*	0.17	0.01	-1.69	-0.03			6	0.46	0.28	0.98	-0.88	1.79
		7	-0.68*	0.12	0.00	-1.23	-0.14			7	0.34	0.25	1.00	-0.90	1.59
	2	3	0.00	0.26	1.00	-1.24	1.24		2	3	0.11	0.29	1.00	-1.38	1.60
		4	-0.21	0.24	1.00	-1.34	0.92			4	0.43	0.30	1.00	-1.05	1.92
		5	-0.46	0.30	0.99	-1.89	0.98			5	0.92	0.43	0.79	-1.16	2.99
		6	-0.38	0.24	0.98	-1.50	0.75			6	1.35	0.32	0.03	-0.17	2.87
		7	-0.20	0.20	1.00	-1.30	0.89			7	1.24	0.28	0.04	-0.25	2.73
	3	4	-0.21	0.24	1.00	-1.34	0.92		3	4	0.32	0.20	0.98	-0.61	1.26
		5	-0.46	0.30	0.99	-1.89	0.98			5	0.81	0.37	0.82	-1.27	2.88
		6	-0.38	0.24	0.98	-1.50	0.75			6	1.24*	0.23	0.00	0.15	2.34
		7	-0.20	0.20	1.00	-1.30	0.89			7	1.12*	0.18	0.00	0.30	1.96
	4	5	-0.25	0.28	1.00	-1.63	1.14		4	5	0.48	0.38	1.00	-1.56	2.53
		6	-0.17	0.21	1.00	-1.13	0.79			6	0.92	0.24	0.05	-0.21	2.05
		7	0.01	0.17	1.00	-0.85	0.86			7	0.81	0.19	0.03	-0.11	1.72
	5	6	0.08	0.28	1.00	-1.30	1.46		5	6	0.44	0.39	1.00	-1.59	2.46
		7	0.25	0.25	1.00	-1.16	1.67			7	0.32	0.37	1.00	-1.76	2.41
	6	7	0.17	0.17	1.00	-0.66	1.00		6	7	-0.11	0.22	1.00	-1.20	0.97
SL	0	1	-0.55	0.21	0.43	-1.56	0.46	MSL	0	1	-0.24	0.32	1.00	-1.87	1.39
		2	-0.76	0.19	0.07	-1.76	0.23			2	-0.86	0.41	0.86	-3.16	1.45
		3	-0.86	0.19	0.03	-1.87	0.15			3	-0.85	0.30	0.37	-2.37	0.67
		4	-0.91	0.19	0.02	-1.91	0.10			4	-1.53*	0.27	0.00	-2.85	-0.21
		5	-1.11*	0.22	0.01	-2.17	-0.06			5	-1.36*	0.20	0.00	-2.28	-0.44
		6	-0.96	0.21	0.02	-1.98	0.06			6	-1.18*	0.20	0.00	-2.11	-0.26
		7	-1.15*	0.23	0.01	-2.23	-0.07			7	-1.08*	0.17	0.00	-1.94	-0.24
		2	-0.21	0.14	0.99	-0.90	0.47			2	-0.61	0.48	1.00	-2.91	1.69

	1	3	-0.31	0.13	0.69	-0.97	0.35		1	3	-0.61	0.38	0.98	-2.40	1.19
		4	-0.36	0.14	0.47	-1.02	0.31			4	-1.29	0.36	0.09	-2.99	0.42
		5	-0.56	0.18	0.22	-1.43	0.31			5	-1.12	0.31	0.13	-2.75	0.52
		6	-0.41	0.17	0.55	-1.19	0.37			6	-0.94	0.31	0.30	-2.58	0.70
		7	-0.60	0.19	0.19	-1.51	0.31			7	-0.84	0.30	0.43	-2.52	0.83
	2	3	-0.09	0.12	1.00	-0.64	0.46		2	3	0.01	0.47	1.00	-2.27	2.28
		4	-0.14	0.12	1.00	-0.70	0.42			4	-0.67	0.45	0.99	-2.93	1.58
		5	-0.35	0.17	0.84	-1.19	0.49			5	-0.50	0.41	1.00	-2.82	1.82
		6	-0.20	0.15	1.00	-0.93	0.54			6	-0.33	0.41	1.00	-2.65	1.99
		7	-0.39	0.18	0.77	-1.27	0.50			7	-0.23	0.40	1.00	-2.61	2.15
	3	4	-0.05	0.11	1.00	-0.54	0.44		3	4	-0.68	0.35	0.87	-2.31	0.94
		5	-0.26	0.16	0.99	-1.10	0.58			5	-0.51	0.29	0.96	-2.03	1.01
		6	-0.10	0.14	1.00	-0.82	0.62			6	-0.33	0.29	1.00	-1.86	1.19
		7	-0.29	0.17	0.97	-1.18	0.60			7	-0.24	0.28	1.00	-1.80	1.32
	4	5	-0.21	0.16	1.00	-1.05	0.63		4	5	0.17	0.26	1.00	-1.14	1.49
		6	-0.06	0.15	1.00	-0.78	0.67			6	0.35	0.26	1.00	-0.97	1.66
		7	-0.24	0.17	1.00	-1.13	0.64			7	0.44	0.25	0.95	-0.88	1.77
	5	6	0.15	0.19	1.00	-0.74	1.05		5	6	0.18	0.19	1.00	-0.70	1.06
		7	-0.04	0.21	1.00	-1.02	0.95			7	0.27	0.16	0.97	-0.52	1.06
	6	7	-0.19	0.20	1.00	-1.12	0.74		6	7	0.10	0.16	1.00	-0.70	0.89
SLR	0	1	-0.76*	0.16	0.01	-1.51	-0.03	MSLR	0	1	-0.31	0.27	1.00	-1.60	0.98
		2	-1.12*	0.11	0.00	-1.69	-0.57			2	-1.09	0.27	0.04	-2.41	0.22
		3	-1.15*	0.15	0.00	-1.88	-0.43			3	-1.03*	0.22	0.01	-2.07	-0.01
		4	-1.25*	0.16	0.00	-2.02	-0.48			4	-0.86	0.26	0.14	-2.10	0.38
		5	-1.33*	0.17	0.00	-2.14	-0.53			5	-0.88	0.25	0.11	-2.09	0.34
		6	-1.28*	0.16	0.00	-2.03	-0.54			6	-0.95	0.28	0.16	-2.35	0.45
		7	-1.36*	0.23	0.00	-2.55	-0.17			7	-1.03	0.24	0.02	-2.17	0.12
	1	2	-0.36	0.13	0.48	-1.09	0.37		1	2	-0.78	0.31	0.51	-2.25	0.68
		3	-0.38	0.17	0.69	-1.18	0.41			3	-0.73	0.27	0.42	-2.03	0.58
		4	-0.48	0.18	0.39	-1.32	0.35			4	-0.55	0.30	0.93	-1.97	0.86
		5	-0.57	0.18	0.20	-1.42	0.29			5	-0.57	0.30	0.90	-1.97	0.83
		6	-0.52	0.17	0.25	-1.33	0.30			6	-0.64	0.33	0.87	-2.16	0.89
		7	-0.59	0.24	0.56	-1.78	0.59			7	-0.71	0.29	0.54	-2.07	0.64
	2	3	-0.02	0.13	1.00	-0.72	0.68		2	3	0.06	0.28	1.00	-1.27	1.38
		4	-0.12	0.14	1.00	-0.89	0.65			4	0.23	0.31	1.00	-1.20	1.66
		5	-0.21	0.14	1.00	-1.02	0.60			5	0.22	0.30	1.00	-1.20	1.63

		6	-0.16	0.13	1.00	-0.89	0.58			6	0.15	0.33	1.00	-1.39	1.68
		7	-0.23	0.21	1.00	-1.49	1.02			7	0.07	0.29	1.00	-1.31	1.45
	3	4	-0.10	0.18	1.00	-0.92	0.72		3	4	0.18	0.26	1.00	-1.07	1.43
		5	-0.18	0.18	1.00	-1.03	0.66			5	0.16	0.26	1.00	-1.07	1.39
		6	-0.13	0.17	1.00	-0.93	0.67			6	0.09	0.29	1.00	-1.32	1.50
		7	-0.21	0.24	1.00	-1.40	0.98			7	0.01	0.25	1.00	-1.14	1.17
	4	5	-0.09	0.19	1.00	-0.96	0.79		4	5	-0.01	0.29	1.00	-1.37	1.35
		6	-0.04	0.18	1.00	-0.87	0.80			6	-0.09	0.32	1.00	-1.58	1.41
		7	-0.11	0.24	1.00	-1.30	1.08			7	-0.16	0.28	1.00	-1.48	1.15
	5	6	0.05	0.18	1.00	-0.81	0.91		5	6	-0.07	0.31	1.00	-1.55	1.41
		7	-0.03	0.24	1.00	-1.22	1.17			7	-0.15	0.28	1.00	-1.44	1.14
	6	7	-0.08	0.24	1.00	-1.27	1.11		6	7	-0.08	0.30	1.00	-1.52	1.37

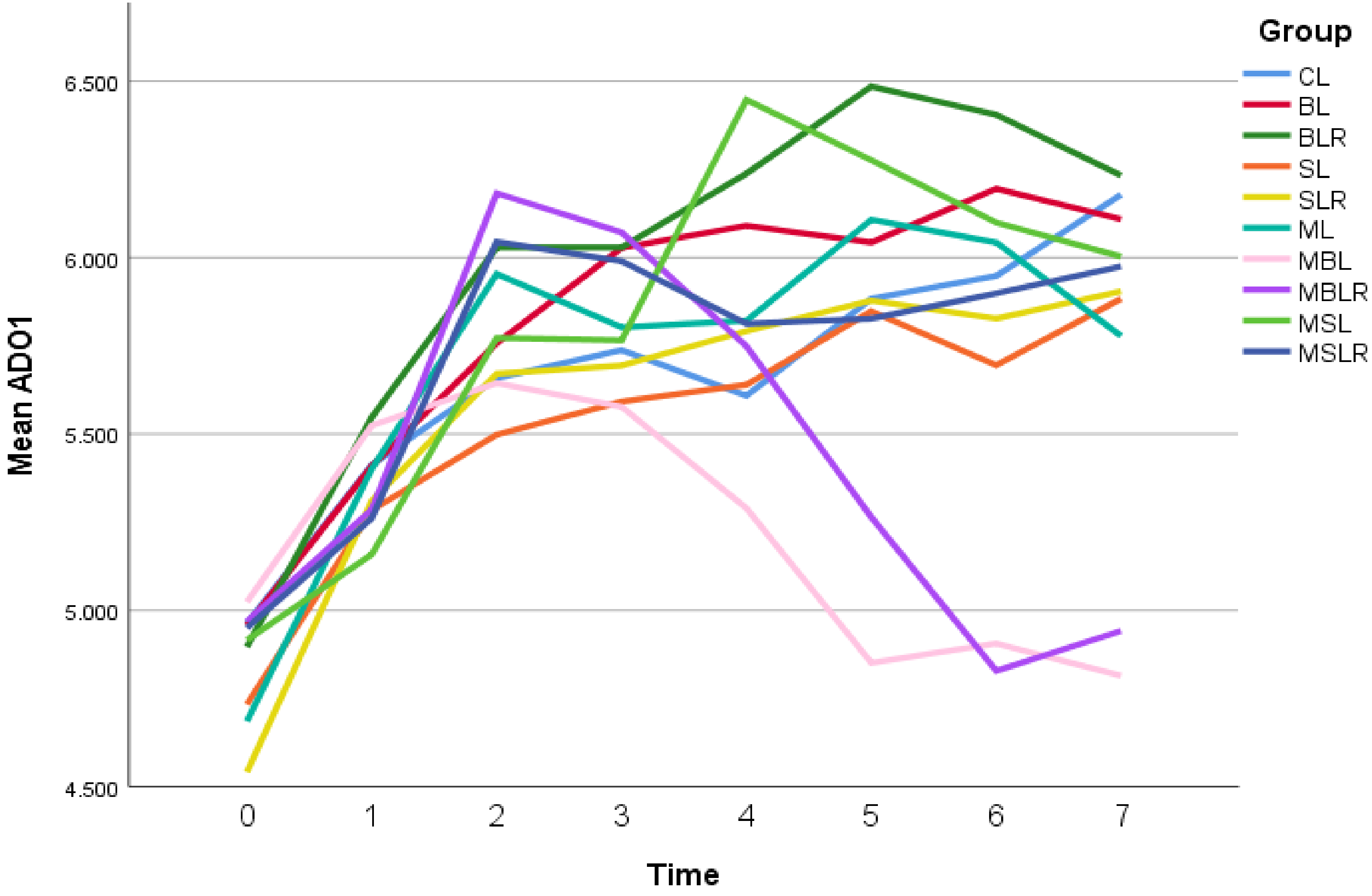


Figure 50: Line Graph of mean ADO1 (mm) for LC-LT Groups from T0 to T7

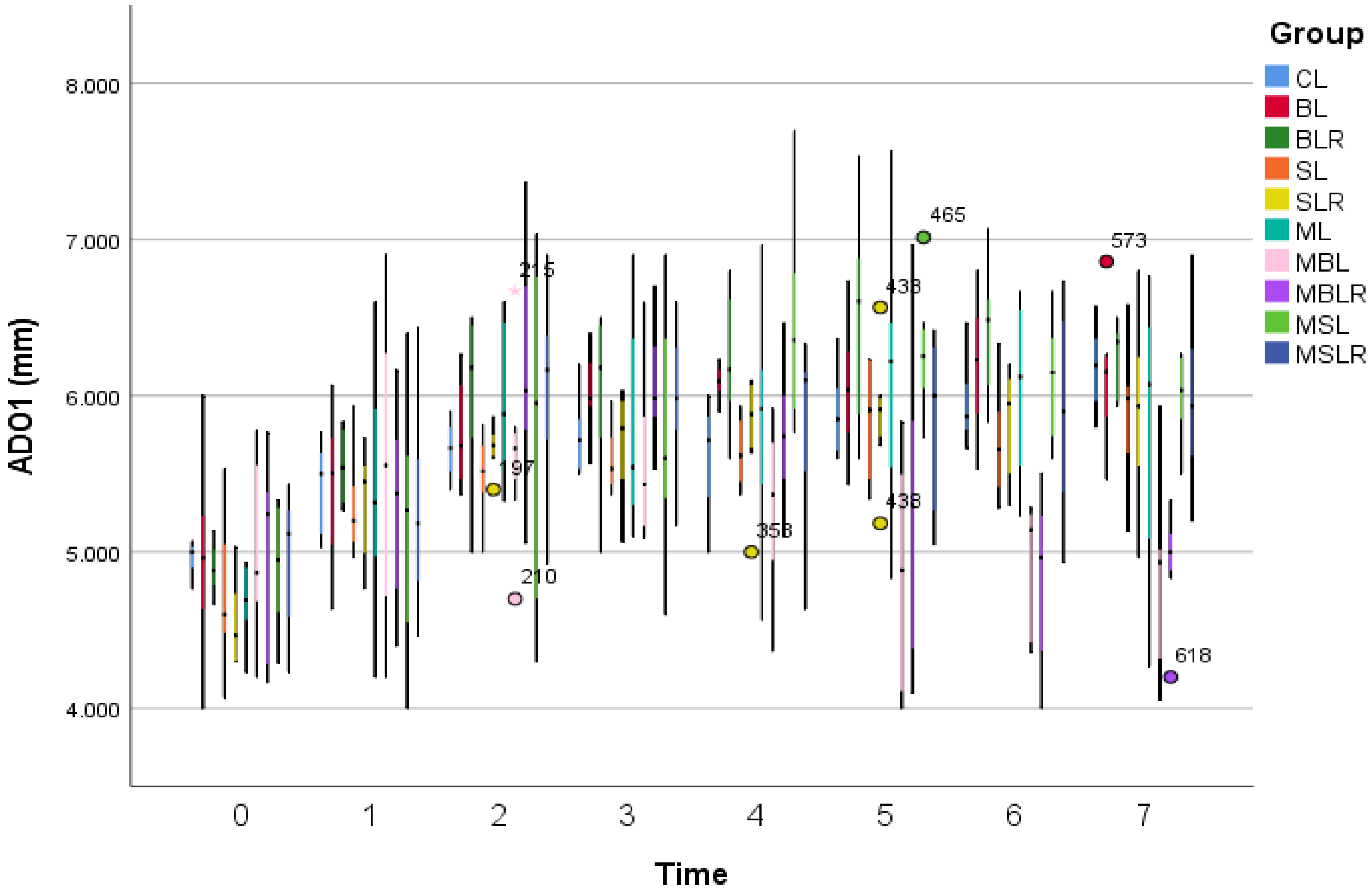


Figure 51: Boxplot ADO1 for LC-LT Groups from T0 to T7

5.2.2.11 LC-LT Groups Mandibular Plane Angle (MPA)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for MPA are displayed below (Table XXXIII). A line graph of the group means and a boxplot of MPA are displayed below in Figures 52 and 53. At T1 the ML, MBL, MBLR, and MSL groups had a significantly increased MPA than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MSLR group had a significantly increased MPA than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). At T2 the ML, MBL, and MBLR groups had a significantly increased MPA than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MSL group had a significantly increased MPA than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). The MSLR group had a significantly increased MPA than the CL, SL, and SLR groups ($p \leq 0.01$). At T3 the ML, MBL, MSL, and MSLR groups had a significantly increased MPA than the CL, SL, and SLR groups ($p \leq 0.001$). The MBLR group had a significantly increased MPA than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). The BLR group had a significantly increased MPA than the CL group ($p \leq 0.001$). At T4 the ML group had a significantly increased MPA than the CL and SLR groups ($p \leq 0.01$). The MBLR group had a significantly increased MPA than the CL, SL, SLR, and MBL groups ($p \leq 0.01$). The BLR group had a significantly increased MPA than the CL group ($p \leq 0.001$). At T5 the ML group had a significantly increased MPA than the CL group ($p \leq 0.001$). The MBLR group had a significantly greater MPA than the CL group ($p \leq 0.001$). The MSL group had a significantly increased MPA than the CL group ($p \leq 0.01$). The BLR group had a significantly increased MPA than the CL group ($p \leq 0.001$). At T6 the MBLR group had a significantly increased MPA than the CL, SL, ML, and MBL group ($p \leq 0.01$). The BLR group had a significantly increased MPA than the CL group ($p \leq 0.01$). The MBLR group finished with the largest MPA.

Table XXXIII: Multiple Comparisons Within Groups LC-LT for MPA

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	0.10	0.24	1.00	-1.05	1.24	ML	0	1	-4.22*	0.32	0.00	-5.84	-2.60
		2	-0.01	0.22	1.00	-1.13	1.11			2	-4.98*	0.40	0.00	-7.11	-2.86
		3	0.44	0.27	0.98	-0.84	1.72			3	-6.80*	0.80	0.00	-11.66	-1.96
		4	0.00	0.25	1.00	-1.17	1.16			4	-2.33*	0.32	0.00	-3.90	-0.77
		5	0.55	0.31	0.95	-0.92	2.02			5	-1.73*	0.22	0.00	-2.76	-0.70
		6	0.37	0.35	1.00	-1.35	2.09			6	-0.78	0.28	0.35	-2.12	0.56
		7	-0.52	0.28	0.90	-1.81	0.77			7	-0.91	0.37	0.63	-2.86	1.04
	1	2	-0.10	0.18	1.00	-0.97	0.77		1	2	-0.76	0.46	0.97	-2.94	1.42
		3	0.34	0.24	1.00	-0.82	1.50			3	-2.59	0.83	0.30	-7.25	2.07

		4	-0.10	0.21	1.00	-1.08	0.88			4	1.88*	0.39	0.01	0.07	3.70
		5	0.45	0.28	0.98	-0.96	1.87			5	2.48*	0.32	0.00	0.87	4.11
		6	0.27	0.33	1.00	-1.44	1.99			6	3.43*	0.36	0.00	1.74	5.14
		7	-0.62	0.24	0.52	-1.80	0.56			7	3.31*	0.44	0.00	1.26	5.37
	2	3	0.45	0.23	0.88	-0.69	1.58		2	3	-1.83	0.86	0.82	-6.39	2.74
		4	0.00	0.19	1.00	-0.91	0.92			4	2.64*	0.45	0.00	0.48	4.81
		5	0.56	0.27	0.85	-0.87	1.98			5	3.25*	0.39	0.00	1.11	5.39
		6	0.38	0.32	1.00	-1.36	2.12			6	4.20*	0.43	0.00	2.09	6.32
		7	-0.51	0.23	0.74	-1.67	0.64			7	4.07*	0.49	0.00	1.77	6.38
	3	4	-0.44	0.25	0.94	-1.62	0.73		3	4	4.47	0.83	0.01	-0.20	9.15
		5	0.11	0.31	1.00	-1.37	1.59			5	5.07*	0.79	0.01	0.20	9.96
		6	-0.07	0.35	1.00	-1.80	1.65			6	6.02*	0.81	0.00	1.28	10.78
		7	-0.96	0.28	0.10	-2.26	0.34			7	5.90*	0.85	0.00	1.31	10.49
	4	5	0.55	0.29	0.90	-0.87	1.98		4	5	0.60	0.31	0.89	-0.96	2.17
		6	0.37	0.33	1.00	-1.34	2.08			6	1.55	0.35	0.02	-0.10	3.21
		7	-0.52	0.25	0.82	-1.71	0.68			7	1.43	0.43	0.14	-0.61	3.46
	5	6	-0.18	0.38	1.00	-1.99	1.62		5	6	0.95	0.27	0.11	-0.37	2.27
		7	-1.07	0.31	0.12	-2.56	0.42			7	0.82	0.37	0.76	-1.14	2.79
	6	7	-0.89	0.35	0.54	-2.62	0.84		6	7	-0.13	0.40	1.00	-2.09	1.84
BL	0	1	-0.26	0.26	1.00	-1.50	0.97	MBL	0	1	-4.25*	0.45	0.00	-6.41	-2.09
		2	-0.70	0.26	0.41	-1.94	0.54			2	-3.79*	0.37	0.00	-5.97	-1.63
		3	-1.48*	0.30	0.01	-2.90	-0.07			3	-5.02*	0.76	0.00	-8.96	-1.09
		4	-1.47	0.39	0.09	-3.45	0.51			4	-0.62	0.50	1.00	-2.94	1.70
		5	-1.54	0.37	0.04	-3.40	0.31			5	0.05	0.42	1.00	-2.04	2.13
		6	-1.69	0.51	0.22	-4.49	1.11			6	-0.22	0.37	1.00	-2.38	1.95
		7	-0.76	0.34	0.73	-2.43	0.90			7	-0.33	0.42	1.00	-2.42	1.75
	1	2	-0.44	0.25	0.95	-1.61	0.73		1	2	0.45	0.30	0.99	-1.20	2.11
		3	-1.22	0.29	0.03	-2.60	0.15			3	-0.77	0.73	1.00	-4.76	3.21
		4	-1.20	0.38	0.24	-3.18	0.78			4	3.62*	0.44	0.00	1.53	5.72
		5	-1.28	0.36	0.13	-3.13	0.57			5	4.29*	0.36	0.00	2.61	5.99
		6	-1.43	0.51	0.43	-4.26	1.40			6	4.03*	0.30	0.00	2.38	5.69
		7	-0.50	0.33	0.99	-2.14	1.14			7	3.91*	0.35	0.00	2.24	5.59
	2	3	-0.78	0.29	0.40	-2.16	0.60		2	3	-1.23	0.68	0.97	-5.48	3.03
		4	-0.76	0.38	0.88	-2.74	1.22			4	3.17*	0.36	0.00	1.09	5.25
		5	-0.84	0.36	0.70	-2.69	1.01			5	3.84*	0.24	0.00	2.56	5.13
		6	-0.99	0.51	0.91	-3.81	1.83			6	3.58*	0.15	0.00	2.87	4.29

		7	-0.06	0.33	1.00	-1.70	1.58			7	3.46*	0.24	0.00	2.23	4.69
	3	4	0.02	0.41	1.00	-1.98	2.02		3	4	4.39*	0.76	0.00	0.46	8.34
		5	-0.06	0.39	1.00	-1.94	1.83			5	5.06*	0.71	0.00	1.00	9.14
		6	-0.21	0.53	1.00	-2.98	2.56			6	4.80*	0.68	0.01	0.55	9.06
		7	0.72	0.36	0.86	-1.00	2.44			7	4.68*	0.71	0.00	0.61	8.77
	4	5	-0.08	0.47	1.00	-2.26	2.10		4	5	0.67	0.41	0.98	-1.34	2.68
		6	-0.23	0.58	1.00	-3.04	2.59			6	0.41	0.36	1.00	-1.67	2.48
		7	0.70	0.44	0.98	-1.38	2.79			7	0.29	0.40	1.00	-1.71	2.29
	5	6	-0.15	0.57	1.00	-2.94	2.64		5	6	-0.26	0.25	1.00	-1.55	1.02
		7	0.78	0.42	0.93	-1.22	2.77			7	-0.38	0.31	1.00	-1.81	1.05
	6	7	0.93	0.55	0.97	-1.83	3.69		6	7	-0.12	0.24	1.00	-1.35	1.11
BLR	0	1	-0.77	0.39	0.87	-2.60	1.06	MBLR	0	1	-4.51*	0.54	0.00	-7.25	-1.77
		2	-0.34	0.40	1.00	-2.23	1.55			2	-6.42*	0.69	0.00	-10.15	-2.69
		3	-0.84	0.29	0.38	-2.43	0.76			3	-6.79*	0.80	0.00	-11.28	-2.32
		4	-2.05	0.46	0.02	-4.24	0.14			4	-3.31*	0.38	0.00	-5.09	-1.54
		5	-1.67	0.42	0.04	-3.66	0.32			5	-2.65*	0.40	0.00	-4.55	-0.77
		6	-1.67	0.40	0.03	-3.55	0.22			6	-1.72*	0.33	0.01	-3.34	-0.12
		7	-0.64	0.34	0.91	-2.26	0.98			7	-1.32	0.46	0.31	-3.53	0.89
	1	2	0.43	0.41	1.00	-1.51	2.37		1	2	-1.91	0.79	0.59	-5.69	1.87
		3	-0.07	0.30	1.00	-1.78	1.63			3	-2.29	0.89	0.50	-6.67	2.10
		4	-1.29	0.47	0.37	-3.50	0.93			4	1.20	0.54	0.75	-1.54	3.93
		5	-0.91	0.43	0.79	-2.94	1.12			5	1.85	0.56	0.16	-0.90	4.60
		6	-0.90	0.41	0.74	-2.84	1.04			6	2.78*	0.51	0.01	0.00	5.56
		7	0.13	0.35	1.00	-1.57	1.82			7	3.19*	0.60	0.00	0.35	6.04
	2	3	-0.50	0.32	0.99	-2.31	1.31		2	3	-0.38	0.98	1.00	-5.01	4.26
		4	-1.71	0.48	0.08	-3.96	0.54			4	3.11	0.69	0.04	-0.63	6.84
		5	-1.34	0.44	0.23	-3.41	0.74			5	3.76*	0.70	0.01	0.06	7.47
		6	-1.33	0.43	0.19	-3.32	0.66			6	4.69*	0.66	0.00	0.85	8.53
		7	-0.30	0.37	1.00	-2.08	1.47			7	5.10*	0.73	0.00	1.41	8.79
	3	4	-1.21	0.38	0.31	-3.47	1.04		3	4	3.48	0.80	0.05	-1.01	7.97
		5	-0.84	0.34	0.67	-2.81	1.13			5	4.14	0.81	0.02	-0.31	8.59
		6	-0.83	0.32	0.56	-2.64	0.98			6	5.07*	0.78	0.01	0.46	9.68
		7	0.20	0.23	1.00	-1.03	1.43			7	5.47*	0.84	0.00	1.10	9.86
	4	5	0.38	0.49	1.00	-1.93	2.69		4	5	0.66	0.40	0.98	-1.22	2.53
		6	0.39	0.48	1.00	-1.86	2.63			6	1.58*	0.33	0.01	0.01	3.16
		7	1.41	0.42	0.17	-0.73	3.56			7	1.99	0.46	0.02	-0.20	4.19

	5	6	0.01	0.44	1.00	-2.07	2.08		5	6	0.93	0.35	0.47	-0.81	2.68
		7	1.03	0.39	0.44	-0.87	2.94			7	1.34	0.48	0.33	-0.92	3.59
	6	7	1.03	0.37	0.36	-0.75	2.80		6	7	0.41	0.42	1.00	-1.75	2.56
SL	0	1	0.30	0.25	1.00	-0.88	1.49	MSL	0	1	-4.13*	0.49	0.00	-6.56	-1.70
		2	0.21	0.25	1.00	-0.96	1.39			2	-3.95*	0.53	0.00	-6.62	-1.29
		3	-0.15	0.22	1.00	-1.19	0.90			3	-3.23*	0.47	0.00	-5.53	-0.94
		4	-0.11	0.26	1.00	-1.31	1.08			4	-1.79	0.49	0.09	-4.20	0.62
		5	-0.60	0.41	1.00	-2.79	1.59			5	-1.15	0.43	0.41	-3.18	0.89
		6	-0.27	0.25	1.00	-1.42	0.88			6	-0.41	0.31	1.00	-1.95	1.13
		7	-0.55	0.37	1.00	-2.48	1.38			7	-0.88	0.36	0.58	-2.58	0.83
	1	2	-0.09	0.26	1.00	-1.30	1.12		1	2	0.17	0.62	1.00	-2.73	3.07
		3	-0.45	0.23	0.86	-1.54	0.64			3	0.89	0.57	0.99	-1.77	3.56
		4	-0.42	0.26	0.98	-1.64	0.81			4	2.34	0.59	0.04	-0.39	5.08
		5	-0.90	0.42	0.80	-3.09	1.28			5	2.98*	0.54	0.00	0.45	5.52
		6	-0.57	0.25	0.67	-1.75	0.60			6	3.72*	0.45	0.00	1.27	6.17
		7	-0.85	0.38	0.73	-2.78	1.07			7	3.25*	0.49	0.00	0.83	5.68
	2	3	-0.36	0.22	0.98	-1.44	0.72		2	3	0.72	0.60	1.00	-2.11	3.55
		4	-0.33	0.26	1.00	-1.55	0.89			4	2.17	0.62	0.09	-0.72	5.06
		5	-0.81	0.42	0.90	-3.00	1.37			5	2.80*	0.57	0.01	0.08	5.54
		6	-0.48	0.25	0.88	-1.65	0.69			6	3.54*	0.49	0.00	0.83	6.27
		7	-0.76	0.38	0.86	-2.69	1.16			7	3.00*	0.52	0.00	0.42	5.74
	3	4	0.03	0.23	1.00	-1.07	1.14		3	4	1.45	0.57	0.48	-1.20	4.10
		5	-0.45	0.40	1.00	-2.69	1.79			5	2.09	0.52	0.03	-0.34	4.51
		6	-0.12	0.22	1.00	-1.16	0.91			6	2.82*	0.43	0.00	0.54	5.11
		7	-0.40	0.36	1.00	-2.36	1.55			7	2.36*	0.46	0.01	0.08	4.64
	4	5	-0.48	0.42	1.00	-2.67	1.70		4	5	0.64	0.53	1.00	-1.88	3.16
		6	-0.16	0.25	1.00	-1.35	1.04			6	1.38	0.45	0.30	-1.05	3.80
		7	-0.44	0.38	1.00	-2.36	1.49			7	0.91	0.48	0.92	-1.49	3.31
	5	6	0.33	0.41	1.00	-1.86	2.52		5	6	0.74	0.38	0.90	-1.23	2.70
		7	0.05	0.50	1.00	-2.30	2.40			7	0.27	0.42	1.00	-1.75	2.29
	6	7	-0.28	0.37	1.00	-2.21	1.65		6	7	-0.47	0.31	0.99	-1.96	1.02
SLR	0	1	-0.40	0.28	1.00	-1.78	0.97	MSLR	0	1	-4.27*	0.52	0.00	-6.84	-1.71
		2	-0.51	0.27	0.92	-1.87	0.85			2	-3.63*	0.63	0.01	-6.94	-0.34
		3	-0.82	0.35	0.64	-2.49	0.84			3	-3.02*	0.48	0.00	-5.34	-0.71
		4	-0.85	0.28	0.26	-2.22	0.52			4	-1.67	0.45	0.07	-3.80	0.46
		5	-0.96	0.43	0.71	-3.05	1.13			5	-1.18	0.46	0.49	-3.38	1.02

		6	-0.91	0.49	0.94	-3.45	1.63			6	-0.75	0.51	0.99	-3.24	1.74
		7	-0.71	0.42	0.97	-2.79	1.37			7	-1.10	0.47	0.63	-3.34	1.14
	1	2	-0.11	0.21	1.00	-1.11	0.90		1	2	0.64	0.72	1.00	-2.77	4.05
		3	-0.42	0.31	1.00	-1.97	1.13			3	1.25	0.59	0.77	-1.50	4.01
		4	-0.45	0.23	0.87	-1.51	0.62			4	2.61*	0.56	0.01	-0.05	5.27
		5	-0.56	0.39	1.00	-2.65	1.53			5	3.09*	0.57	0.00	0.40	5.80
		6	-0.51	0.47	1.00	-3.10	2.09			6	3.52*	0.61	0.00	0.67	6.38
		7	-0.31	0.39	1.00	-2.39	1.77			7	3.17*	0.58	0.00	0.46	5.89
	2	3	-0.31	0.30	1.00	-1.87	1.24		2	3	0.61	0.69	1.00	-2.72	3.95
		4	-0.34	0.21	0.98	-1.33	0.65			4	1.97	0.67	0.29	-1.34	5.27
		5	-0.45	0.38	1.00	-2.57	1.67			5	2.46	0.67	0.09	-0.85	5.78
		6	-0.40	0.46	1.00	-3.04	2.24			6	2.89	0.71	0.04	-0.50	6.27
		7	-0.20	0.38	1.00	-2.31	1.90			7	2.54	0.68	0.08	-0.78	5.86
	3	4	-0.03	0.31	1.00	-1.58	1.53		3	4	1.35	0.52	0.46	-1.10	3.81
		5	-0.14	0.45	1.00	-2.27	2.00			5	1.85	0.54	0.10	-0.66	4.35
		6	-0.09	0.51	1.00	-2.63	2.46			6	2.27	0.58	0.04	-0.43	4.97
		7	0.11	0.44	1.00	-2.01	2.23			7	1.93	0.54	0.08	-0.60	4.45
	4	5	-0.11	0.39	1.00	-2.21	1.98		4	5	0.49	0.51	1.00	-1.88	2.86
		6	-0.06	0.46	1.00	-2.66	2.54			6	0.92	0.55	0.97	-1.68	3.52
		7	0.14	0.39	1.00	-1.94	2.22			7	0.57	0.51	1.00	-1.83	2.97
	5	6	0.05	0.56	1.00	-2.62	2.72		5	6	0.43	0.56	1.00	-2.21	3.06
		7	0.25	0.50	1.00	-2.11	2.60			7	0.08	0.52	1.00	-2.37	2.53
	6	7	0.20	0.56	1.00	-2.47	2.86		6	7	-0.35	0.57	1.00	-3.01	2.31

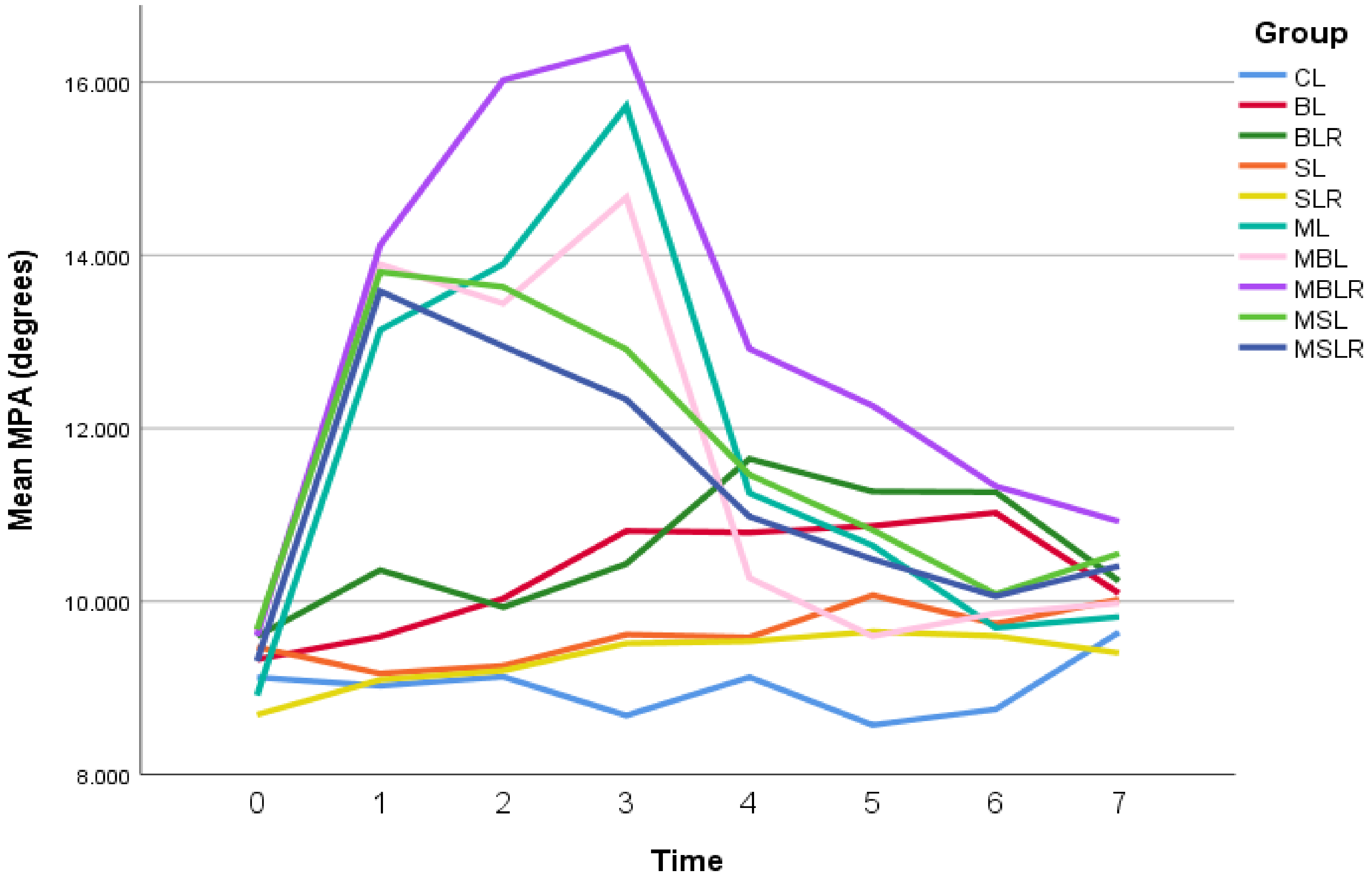


Figure 52: Line Graph of mean MPA (º) for DVC-LT Groups from T0 to T7

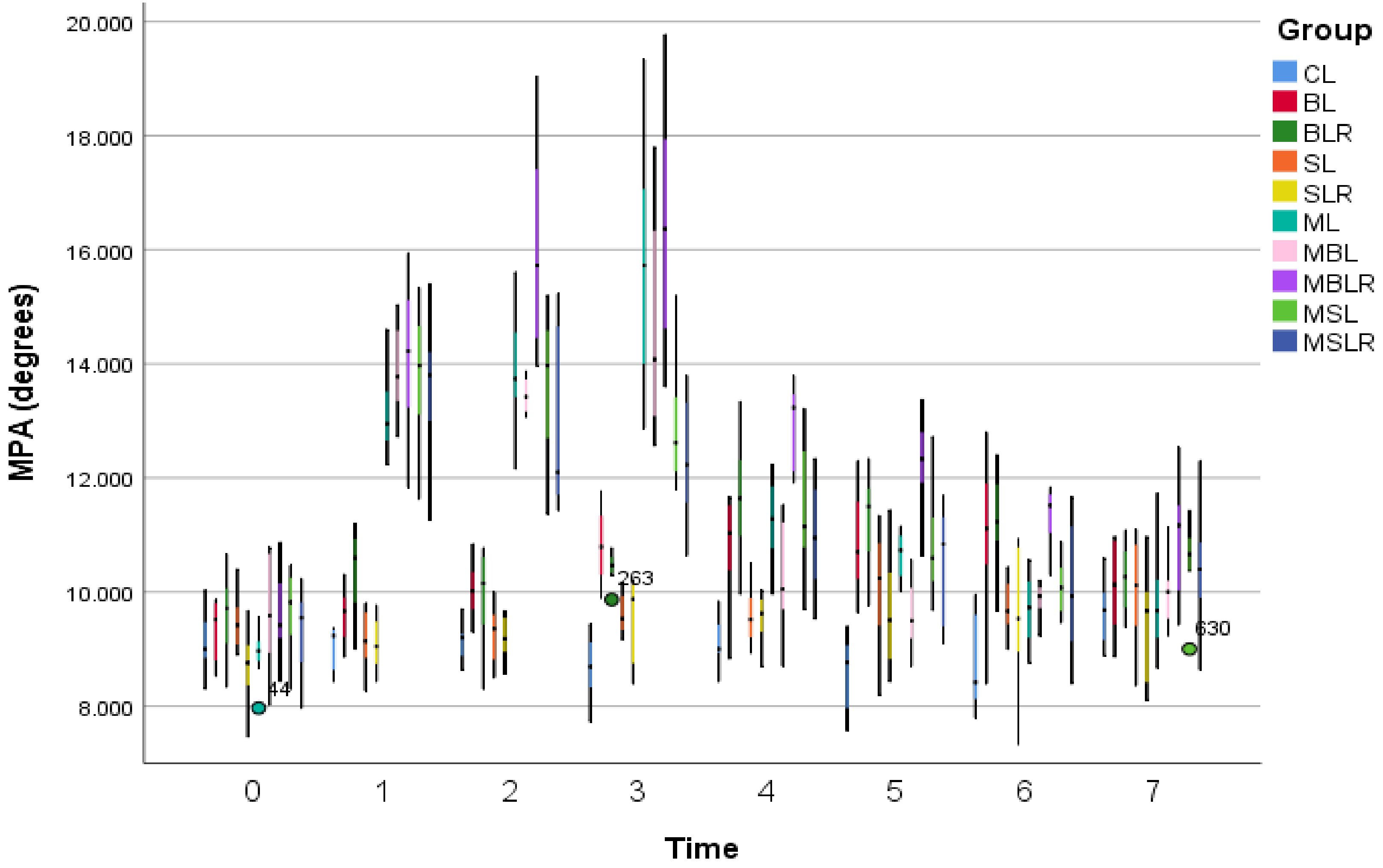


Figure 53: Line Graph of MPA (º) for DVC-LT Groups from T0 to T7

5.2.2.12 LC-LT Groups Angle of Opening (AoO)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for AoO are displayed below (Table XXXIV). A line graph of the group means and a boxplot of AoO are displayed below in Figures 54 and 55. At T1 the ML and MSLR groups had a significantly increased AoO than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MBL and MSL groups had a significantly increased AoO than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). At T2 the ML, MBLR, MSL, and MSLR groups had a significantly increased AoO than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MBLR had a significantly increased AoO than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). At T3 the ML and the MSLR group had a significantly increased AoO than the SLR groups ($p \leq 0.01$). The MBL, MBLR, and MSL groups had a significantly increased AoO than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). At T4 the MBLR group had a significantly increased AoO than the BL and SL groups ($p \leq 0.01$). From T5 to T7 there were no further significant differences between the groups.

Table XXXIV: Multiple Comparisons Within Groups LC-LT for AoO

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	0.04	0.19	1.00	-0.87	0.94	ML	0	1	-4.31*	0.19	0.00	-5.21	-3.42
		2	0.08	0.19	1.00	-0.82	0.97			2	-3.54	0.33	0.00	-5.30	-1.80
		3	-0.20	0.20	1.00	-1.11	0.72			3	-3.64*	0.57	0.01	-7.05	-0.23
		4	-0.28	0.20	1.00	-1.24	0.67			4	-0.59	0.57	1.00	-3.97	2.79
		5	0.21	0.20	1.00	-0.73	1.15			5	-0.65	0.32	0.87	-2.33	1.03
		6	0.10	0.18	1.00	-0.74	0.94			6	-0.44	0.28	0.99	-1.85	0.97
		7	-0.27	0.16	0.97	-1.09	0.55			7	-0.31	0.27	1.00	-1.66	1.03
	1	2	0.04	0.18	1.00	-0.82	0.90		1	2	0.77	0.33	0.69	-0.99	2.53
		3	-0.23	0.19	1.00	-1.12	0.65			3	0.68	0.57	1.00	-2.76	4.11
		4	-0.32	0.20	0.98	-1.25	0.61			4	3.73*	0.57	0.01	0.33	7.13
		5	0.17	0.19	1.00	-0.74	1.08			5	3.66*	0.32	0.00	1.98	5.36
		6	0.06	0.17	1.00	-0.74	0.86			6	3.87*	0.27	0.00	2.47	5.29
		7	-0.31	0.15	0.86	-1.08	0.46			7	4.00*	0.26	0.00	2.67	5.35
	2	3	-0.27	0.19	0.99	-1.14	0.60		2	3	-0.09	0.63	1.00	-3.33	3.14
		4	-0.36	0.20	0.93	-1.28	0.56			4	2.96	0.63	0.02	-0.24	6.16
		5	0.13	0.19	1.00	-0.77	1.03			5	2.89*	0.42	0.00	0.95	4.85
		6	0.02	0.17	1.00	-0.76	0.81			6	3.10*	0.39	0.00	1.28	4.93

		7	-0.34	0.15	0.68	-1.09	0.40			7	3.23*	0.38	0.00	1.43	5.04
	3	4	-0.09	0.20	1.00	-1.02	0.85		3	4	3.05	0.78	0.04	-0.61	6.71
		5	0.41	0.20	0.81	-0.51	1.32			5	2.99	0.63	0.02	-0.25	6.23
		6	0.30	0.17	0.95	-0.51	1.11			6	3.20*	0.61	0.01	-0.07	6.47
		7	-0.07	0.15	1.00	-0.86	0.71			7	3.32*	0.60	0.01	0.05	6.61
	4	5	0.49	0.21	0.59	-0.47	1.45		4	5	-0.06	0.62	1.00	-3.26	3.14
		6	0.38	0.18	0.79	-0.49	1.26			6	0.15	0.60	1.00	-3.08	3.38
		7	0.01	0.17	1.00	-0.85	0.88			7	0.28	0.60	1.00	-2.97	3.52
	5	6	-0.11	0.18	1.00	-0.96	0.74		5	6	0.21	0.38	1.00	-1.57	1.99
		7	-0.48	0.16	0.31	-1.31	0.35			7	0.34	0.37	1.00	-1.41	2.09
	6	7	-0.37	0.13	0.31	-0.99	0.25		6	7	0.13	0.33	1.00	-1.43	1.69
BL	0	1	-0.22	0.12	0.91	-0.75	0.32	MBL	0	1	-3.81*	0.37	0.00	-5.90	-1.74
		2	-0.19	0.10	0.91	-0.68	0.30			2	-4.58*	0.64	0.00	-8.49	-0.67
		3	-0.16	0.13	1.00	-0.76	0.45			3	-3.89*	0.23	0.00	-5.03	-2.75
		4	0.26	0.14	0.91	-0.42	0.95			4	-0.58	0.41	1.00	-2.94	1.78
		5	-0.22	0.22	1.00	-1.44	1.01			5	-0.38	0.29	1.00	-1.94	1.17
		6	0.26	0.14	0.91	-0.40	0.92			6	0.06	0.17	1.00	-0.76	0.87
		7	-0.28	0.23	1.00	-1.54	0.98			7	-0.05	0.41	1.00	-2.45	2.35
	1	2	0.02	0.11	1.00	-0.50	0.54		1	2	-0.76	0.72	1.00	-4.41	2.88
		3	0.06	0.13	1.00	-0.56	0.68			3	-0.07	0.40	1.00	-2.09	1.95
		4	0.48	0.14	0.14	-0.21	1.17			4	3.23*	0.52	0.00	0.79	5.69
		5	0.00	0.22	1.00	-1.22	1.22			5	3.43*	0.44	0.00	1.35	5.52
		6	0.48	0.14	0.13	-0.20	1.15			6	3.87*	0.37	0.00	1.80	5.95
		7	-0.06	0.23	1.00	-1.32	1.19			7	3.76*	0.53	0.00	1.29	6.24
	2	3	0.04	0.12	1.00	-0.55	0.63		2	3	0.69	0.66	1.00	-3.09	4.48
		4	0.46	0.14	0.15	-0.22	1.13			4	4.00*	0.74	0.01	0.35	7.66
		5	-0.02	0.22	1.00	-1.26	1.22			5	4.19*	0.68	0.00	0.51	7.89
		6	0.45	0.13	0.13	-0.20	1.11			6	4.63*	0.64	0.00	0.73	8.55
		7	-0.08	0.22	1.00	-1.36	1.19			7	4.53*	0.74	0.00	0.87	8.19
	3	4	0.42	0.15	0.36	-0.30	1.14		3	4	3.31*	0.44	0.00	1.03	5.59
		5	-0.06	0.23	1.00	-1.26	1.15			5	3.50*	0.33	0.00	1.93	5.09
		6	0.42	0.15	0.35	-0.29	1.12			6	3.94*	0.23	0.00	2.81	5.09
		7	-0.12	0.23	1.00	-1.36	1.12			7	3.84*	0.44	0.00	1.53	6.15
	4	5	-0.48	0.24	0.86	-1.68	0.72		4	5	0.20	0.47	1.00	-2.10	2.49
		6	0.00	0.16	1.00	-0.76	0.75			6	0.64	0.41	0.99	-1.72	2.99
		7	-0.54	0.24	0.74	-1.77	0.69			7	0.53	0.56	1.00	-2.07	3.13

	5	6	0.48	0.24	0.86	-0.72	1.68		5	6	0.44	0.29	0.99	-1.11	1.99
		7	-0.06	0.30	1.00	-1.44	1.32			7	0.33	0.48	1.00	-1.99	2.66
	6	7	-0.54	0.24	0.74	-1.77	0.69		6	7	-0.11	0.42	1.00	-2.50	2.29
BLR	0	1	-0.35	0.17	0.83	-1.21	0.50	MBLR	0	1	-4.35*	0.48	0.00	-7.34	-1.36
		2	-0.07	0.17	1.00	-0.92	0.79			2	-5.31*	0.33	0.00	-7.28	-3.35
		3	-0.07	0.17	1.00	-0.92	0.79			3	-4.89*	0.46	0.00	-7.72	-2.06
		4	0.16	0.30	1.00	-1.34	1.66			4	-1.79	0.32	0.02	-3.73	0.15
		5	0.25	0.23	1.00	-0.86	1.35			5	-0.36	0.17	0.86	-1.27	0.56
		6	-0.03	0.25	1.00	-1.24	1.18			6	-0.61	0.23	0.53	-1.90	0.68
		7	0.03	0.19	1.00	-0.88	0.95			7	-0.28	0.16	0.97	-1.12	0.56
	1	2	0.29	0.12	0.62	-0.28	0.86		1	2	-0.96	0.57	0.97	-3.75	1.83
		3	0.29	0.12	0.62	-0.28	0.86			3	-0.54	0.65	1.00	-3.60	2.53
		4	0.51	0.27	0.94	-1.05	2.07			4	2.57	0.57	0.02	-0.22	5.35
		5	0.60	0.20	0.33	-0.47	1.67			5	3.99*	0.50	0.00	1.14	6.85
		6	0.32	0.22	1.00	-0.88	1.53			6	3.74*	0.52	0.00	0.96	6.53
		7	0.38	0.15	0.53	-0.36	1.13			7	4.07*	0.50	0.00	1.20	6.95
	2	3	0.00	0.13	1.00	-0.60	0.60		2	3	0.42	0.55	1.00	-2.24	3.09
		4	0.23	0.27	1.00	-1.32	1.77			4	3.52*	0.45	0.00	1.43	5.62
		5	0.31	0.20	0.99	-0.75	1.37			5	4.95*	0.36	0.00	3.09	6.82
		6	0.04	0.22	1.00	-1.16	1.23			6	4.70*	0.39	0.00	2.83	6.58
		7	0.10	0.16	1.00	-0.66	0.85			7	5.03*	0.35	0.00	3.16	6.90
	3	4	0.23	0.27	1.00	-1.32	1.77		3	4	3.10*	0.55	0.00	0.44	5.76
		5	0.31	0.20	0.99	-0.75	1.37			5	4.53*	0.48	0.00	1.84	7.23
		6	0.04	0.22	1.00	-1.16	1.23			6	4.28*	0.50	0.00	1.65	6.91
		7	0.10	0.16	1.00	-0.66	0.85			7	4.60*	0.47	0.00	1.89	7.33
	4	5	0.09	0.32	1.00	-1.44	1.61		4	5	1.43	0.35	0.06	-0.41	3.27
		6	-0.19	0.33	1.00	-1.75	1.37			6	1.18	0.38	0.23	-0.68	3.04
		7	-0.13	0.29	1.00	-1.63	1.38			7	1.51	0.35	0.04	-0.34	3.35
	5	6	-0.27	0.27	1.00	-1.56	1.01		5	6	-0.25	0.27	1.00	-1.53	1.03
		7	-0.21	0.22	1.00	-1.29	0.86			7	0.08	0.21	1.00	-0.92	1.07
	6	7	0.06	0.24	1.00	-1.13	1.25		6	7	0.33	0.26	1.00	-0.94	1.60
SL	0	1	-0.13	0.23	1.00	-1.24	0.98	MSL	0	1	-4.51*	0.63	0.00	-8.16	-0.87
		2	0.16	0.21	1.00	-0.83	1.14			2	-3.71*	0.42	0.00	-5.94	-1.50
		3	-0.13	0.17	1.00	-0.94	0.69			3	-2.79*	0.46	0.00	-5.26	-0.34
		4	0.31	0.28	1.00	-1.13	1.75			4	-1.04	0.27	0.05	-2.31	0.23
		5	0.16	0.19	1.00	-0.74	1.06			5	-0.26	0.23	1.00	-1.37	0.85

		6	0.26	0.18	1.00	-0.60	1.12			6	-0.26	0.25	1.00	-1.44	0.92
		7	-0.08	0.17	1.00	-0.90	0.75			7	-0.19	0.24	1.00	-1.31	0.93
	1	2	0.29	0.24	1.00	-0.86	1.44		1	2	0.79	0.71	1.00	-2.72	4.31
		3	0.00	0.21	1.00	-1.08	1.09			3	1.72	0.73	0.65	-1.84	5.27
		4	0.44	0.31	1.00	-1.04	1.92			4	3.47*	0.63	0.01	-0.15	7.10
		5	0.29	0.23	1.00	-0.82	1.39			5	4.25*	0.62	0.00	0.54	7.97
		6	0.39	0.22	0.95	-0.70	1.48			6	4.25	0.63	0.00	0.59	7.92
		7	0.05	0.21	1.00	-1.03	1.14			7	4.32*	0.62	0.00	0.62	8.03
	2	3	-0.28	0.18	0.99	-1.20	0.64		2	3	0.92	0.57	0.98	-1.73	3.57
		4	0.15	0.29	1.00	-1.30	1.60			4	2.67*	0.43	0.00	0.47	4.89
		5	0.00	0.21	1.00	-0.97	0.97			5	3.46*	0.41	0.00	1.20	5.72
		6	0.10	0.20	1.00	-0.84	1.05			6	3.46*	0.42	0.00	1.23	5.69
		7	-0.23	0.19	1.00	-1.16	0.69			7	3.52*	0.41	0.00	1.28	5.78
	3	4	0.44	0.27	0.98	-1.04	1.91		3	4	1.76	0.46	0.09	-0.69	4.21
		5	0.29	0.16	0.96	-0.50	1.07			5	2.53*	0.44	0.01	0.02	5.05
		6	0.39	0.15	0.50	-0.34	1.11			6	2.54*	0.45	0.01	0.07	5.01
		7	0.05	0.14	1.00	-0.60	0.70			7	2.60*	0.44	0.01	0.10	5.11
	4	5	-0.15	0.28	1.00	-1.59	1.29		4	5	0.78	0.24	0.18	-0.39	1.95
		6	-0.05	0.28	1.00	-1.50	1.40			6	0.78	0.26	0.25	-0.45	2.01
		7	-0.39	0.27	1.00	-1.85	1.08			7	0.85	0.25	0.12	-0.33	2.03
	5	6	0.10	0.18	1.00	-0.73	0.94		5	6	0.00	0.22	1.00	-1.05	1.05
		7	-0.24	0.17	1.00	-1.03	0.56			7	0.07	0.21	1.00	-0.89	1.03
	6	7	-0.34	0.16	0.75	-1.07	0.40		6	7	0.07	0.23	1.00	-1.00	1.14
	0	1	-0.01	0.18	1.00	-0.84	0.82		0	1	-4.90*	0.43	0.00	-7.28	-2.52
		2	-0.03	0.16	1.00	-0.79	0.73			2	-3.48*	0.27	0.00	-4.76	-2.21
		3	0.18	0.24	1.00	-1.05	1.41			3	-2.24*	0.32	0.00	-3.83	-0.65
		4	0.34	0.36	1.00	-1.71	2.39			4	-0.23	0.29	1.00	-1.66	1.20
		5	0.50	0.18	0.38	-0.37	1.37			5	-0.03	0.25	1.00	-1.22	1.16
		6	0.30	0.20	0.99	-0.63	1.24			6	-0.51	0.40	1.00	-2.67	1.64
SLR		7	-0.07	0.22	1.00	-1.17	1.03	MSLR		7	-0.18	0.21	1.00	-1.17	0.82
	1	2	-0.02	0.17	1.00	-0.82	0.77		1	2	1.42	0.46	0.25	-0.92	3.76
		3	0.19	0.25	1.00	-1.04	1.42			3	2.65*	0.49	0.00	0.29	5.03
		4	0.34	0.37	1.00	-1.69	2.38			4	4.67*	0.47	0.00	2.33	7.02
		5	0.51	0.19	0.41	-0.38	1.40			5	4.87*	0.45	0.00	2.53	7.22
		6	0.31	0.20	0.99	-0.64	1.26			6	4.38*	0.54	0.00	1.84	6.94
		7	-0.06	0.23	1.00	-1.17	1.05			7	4.72*	0.42	0.00	2.31	7.13

	2	3	0.21	0.24	1.00	-1.02	1.44		2	3	1.24	0.35	0.09	-0.40	2.89
		4	0.37	0.36	1.00	-1.70	2.44			4	3.25*	0.32	0.00	1.73	4.78
		5	0.53	0.18	0.24	-0.31	1.37			5	3.45*	0.29	0.00	2.11	4.81
		6	0.33	0.19	0.95	-0.58	1.25			6	2.96*	0.42	0.00	0.84	5.10
		7	-0.04	0.22	1.00	-1.13	1.05			7	3.30*	0.25	0.00	2.06	4.55
	3	4	0.15	0.40	1.00	-1.85	2.15		3	4	2.01*	0.37	0.00	0.29	3.73
		5	0.32	0.25	1.00	-0.92	1.56			5	2.21*	0.33	0.00	0.60	3.83
		6	0.12	0.26	1.00	-1.14	1.38			6	1.73	0.46	0.06	-0.46	3.92
		7	-0.25	0.28	1.00	-1.58	1.08			7	2.06*	0.31	0.00	0.47	3.65
	4	5	0.16	0.37	1.00	-1.86	2.19		4	5	0.20	0.31	1.00	-1.28	1.68
		6	-0.03	0.38	1.00	-2.04	1.98			6	-0.29	0.44	1.00	-2.44	1.87
		7	-0.41	0.39	1.00	-2.40	1.59			7	0.05	0.28	1.00	-1.37	1.47
	5	6	-0.20	0.21	1.00	-1.17	0.78		5	6	-0.49	0.41	1.00	-2.62	1.64
		7	-0.57	0.23	0.58	-1.69	0.55			7	-0.15	0.24	1.00	-1.30	1.00
	6	7	-0.37	0.24	0.99	-1.52	0.78		6	7	0.34	0.39	1.00	-1.84	2.51

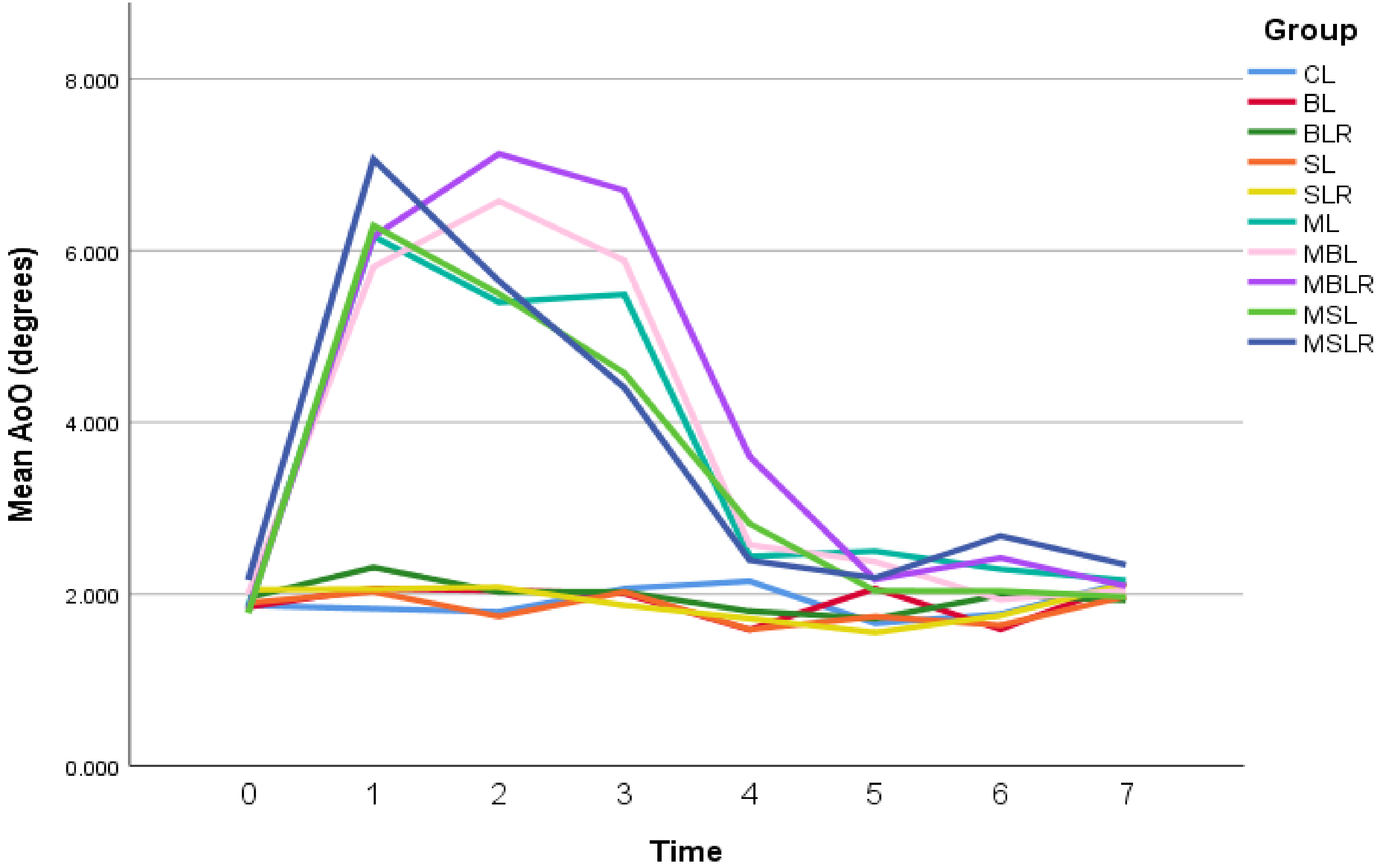


Figure 54: Line Graph of mean AoO (º) for LC-LT Groups from T0 to T7

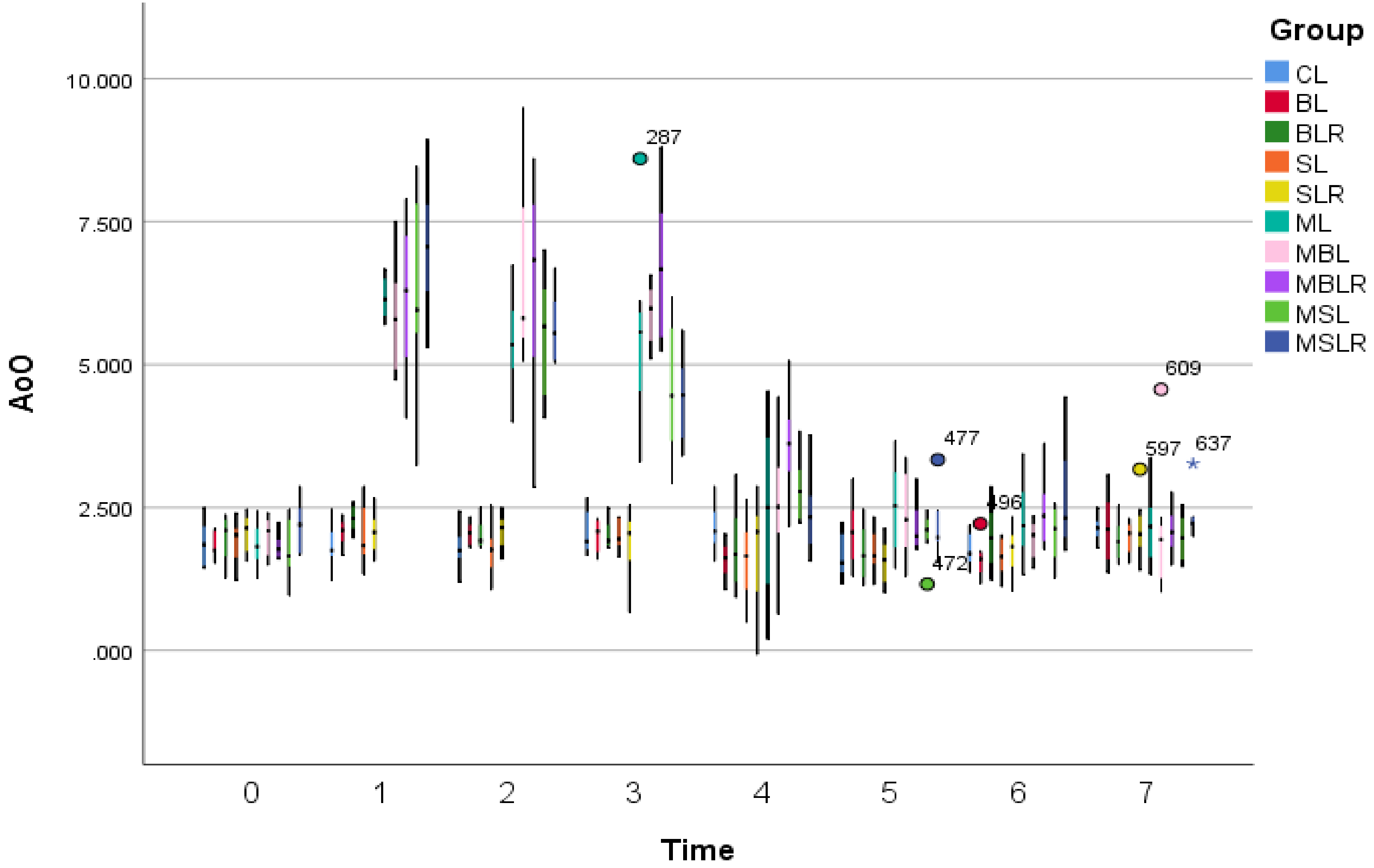


Figure 55: Boxplot AoO (º) for LC-LT Groups from T0 to T7

5.3 Dorsoventral Cephalometric Results

5.3.1 Short-term Dorsoventral Cephalometric Results

The means and standard deviations (SD) for the short-term (ST) Dorsoventral Cephalometric (DVC) groups are displayed below in Table XXXV. Boxplots for those variables without significant findings can be referred to in Appendix 5.

Table XXXV: Means and Standard Deviations for the DVC-ST Groups

Variable		Group					
		C	B	S	M	MB	MS
Time		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001							
Anteroposterior							
O↔N (mm)	T0	32.37 ± 1.65	32.64 ± 1.75	32.65 ± 1.46	33.30 ± 0.79	33.52 ± 0.93	34.49 ± 0.47
	T1	33.96 ± 0.98	33.58 ± 0.84	34.21 ± 1.15	34.39 ± 1.98	33.81 ± 1.36	35.25 ± 0.58
	T2	35.48 ± 0.75	35.02 ± 1.15	35.23 ± 0.42	35.78 ± 1.02	35.71 ± 1.23	36.38 ± 0.63
	T3	36.38 ± 0.91	36.33 ± 0.92	37.07 ± 1.13	36.34 ± 1.13	36.78 ± 2.10	36.92 ± 0.73
CBL (mm)	T0	5.20 ± 0.15	5.21 ± 0.33	5.07 ± 0.36	5.20 ± 0.14	5.12 ± 0.27	5.36 ± 0.29
	T1	5.51 ± 0.16	5.60 ± 0.32	5.57 ± 0.36	5.55 ± 0.22	5.67 ± 0.30	5.61 ± 0.16
	T2	5.85 ± 0.32	6.00 ± 0.21	6.03 ± 0.34	5.95 ± 0.32	5.96 ± 0.27	5.94 ± 0.16
	T3	6.23 ± 0.18	6.40 ± 0.25	6.56 ± 0.54	6.26 ± 0.21	6.27 ± 0.33	6.13 ± 0.19
Zp1↔Za1 (mm)	T0	15.56 ± 0.40	15.58 ± 0.82	15.73 ± 0.35	15.55 ± 0.54	15.60 ± 0.58	16.13 ± 0.33
	T1	16.25 ± 0.57	16.17 ± 0.44	16.45 ± 0.47	15.65 ± 0.62	15.82 ± 0.72	16.61 ± 0.28
	T2	17.15 ± 0.45	16.73 ± 0.57	16.84 ± 0.38	16.34 ± 0.62	16.44 ± 1.12	16.87 ± 0.29
	T3	17.77 ± 0.50	17.31 ± 0.34	17.87 ± 0.34	16.48 ± 0.52	17.06 ± 1.52	17.01 ± 0.31
Zp2↔Za2 (mm)	T0	15.52 ± 0.58	15.30 ± 0.70	15.55 ± 0.45	15.54 ± 0.65	15.58 ± 0.66	15.92 ± 0.21
	T1	16.19 ± 0.56	15.98 ± 0.49	16.22 ± 0.41	15.57 ± 0.56	15.63 ± 0.55	16.34 ± 0.17
	T2	16.97 ± 0.51	16.61 ± 0.47	16.98 ± 0.24	16.27 ± 0.69	16.37 ± 0.56	16.77 ± 0.41
	T3	17.56 ± 0.61	16.97 ± 0.30	17.53 ± 0.30	16.61 ± 0.48	16.89 ± 0.85	16.90 ± 0.49
xGo1 (mm)	T0	-2.14 ± 0.67	-2.17 ± 0.91	-2.16 ± 0.70	-2.29 ± 0.25	-2.57 ± 0.55	-2.31 ± 0.31
	T1	-2.07 ± 0.90	-1.75 ± 0.43	-2.18 ± 0.58	1.49 ± 2.18	2.79 ± 2.23	2.22 ± 3.67
	T2	-2.19 ± 0.73	-1.77 ± 0.55	-1.86 ± 0.34	0.58 ± 1.67	4.51 ± 3.27	1.64 ± 2.81
	T3	-2.45 ± 0.80	-2.29 ± 0.89	-2.28 ± 0.34	0.12 ± 1.65	3.59 ± 2.96	-0.16 ± 2.38
xGo2 (mm)	T0	-3.65 ± 1.47	-2.96 ± 1.32	-3.66 ± 1.52	-3.54 ± 0.77	-4.29 ± 0.55	-3.96 ± 0.69
	T1	-3.85 ± 1.20	-2.80 ± 0.45	-3.04 ± 1.77	2.35 ± 3.28	4.47 ± 3.72	3.13 ± 5.69
	T2	-3.73 ± 1.23	-2.77 ± 1.37	-4.06 ± 0.42	1.09 ± 3.27	4.98 ± 3.65	2.91 ± 5.18
	T3	-3.48 ± 1.96	-3.86 ± 1.41	-4.00 ± 0.86	0.75 ± 3.67	4.12 ± 3.84	0.22 ± 4.77
xCd1 (mm)	T0	6.20 ± 0.59	6.46 ± 0.99	6.32 ± 0.91	6.00 ± 0.27	6.11 ± 0.58	6.45 ± 0.34
	T1	6.65 ± 0.53	7.11 ± 0.75	6.82 ± 0.64	9.86 ± 1.99	10.35 ± 1.71	10.61 ± 3.52
	T2	7.04 ± 0.55	7.45 ± 1.03	7.07 ± 0.71	8.77 ± 1.48	10.88 ± 2.49	9.87 ± 2.73
	T3	6.91 ± 0.63	7.01 ± 0.93	6.91 ± 0.37	8.03 ± 1.48	11.18 ± 2.61	8.36 ± 1.45
xCd2 (mm)	T0	6.82 ± 1.16	7.24 ± 1.42	7.25 ± 1.55	6.64 ± 0.99	6.71 ± 1.03	7.39 ± 0.69
	T1	7.06 ± 0.60	8.28 ± 1.08	8.40 ± 1.42	11.76 ± 2.95	12.08 ± 2.56	12.05 ± 3.05
	T2	7.38 ± 1.03	8.89 ± 1.27	8.30 ± 0.49	10.06 ± 1.62	12.19 ± 2.67	11.86 ± 2.58

	T3	7.60 ± 0.75	7.95 ± 0.96	7.76 ± 0.49	9.82 ± 1.95	12.05 ± 2.53	10.13 ± 2.32
xMx1 (mm)	T0	28.51 ± 0.60	27.94 ± 1.55	27.81 ± 0.87	28.15 ± 0.99	28.00 ± 0.96	28.75 ± 0.35
	T1	29.08 ± 0.41	29.03 ± 0.78	29.40 ± 0.92	28.51 ± 0.88	28.79 ± 1.95	29.48 ± 0.15
	T2	30.32 ± 0.34	29.90 ± 1.18	30.05 ± 0.55	28.85 ± 1.07	28.96 ± 0.88	29.81 ± 0.18
	T3	30.59 ± 0.96	30.08 ± 1.00	30.51 ± 0.59	28.86 ± 0.94	29.50 ± 1.10	30.23 ± 0.60
xMx2 (mm)	T0	28.47 ± 0.36	28.13 ± 1.56	28.24 ± 0.68	28.07 ± 0.86	28.31 ± 1.17	29.12 ± 0.32
	T1	29.42 ± 0.75	29.46 ± 0.89	30.10 ± 0.89	29.28 ± 1.38	28.94 ± 1.27	29.89 ± 0.24
	T2	30.99 ± 0.36	30.40 ± 0.96	30.93 ± 0.57	29.79 ± 0.96	29.50 ± 0.78	30.45 ± 0.36
	T3	31.35 ± 0.89	30.97 ± 0.89	31.39 ± 0.55	29.83 ± 0.76	30.02 ± 1.40	30.82 ± 0.54
Transverse							
Go1↔Go2	T0	16.83 ± 0.28	16.96 ± 0.46	16.88 ± 0.11	16.68 ± 0.12	16.86 ± 0.43	17.16 ± 0.31
	T1	17.16 ± 0.39	17.12 ± 0.22	17.34 ± 0.10	15.72 ± 0.62	15.56 ± 0.88	16.15 ± 1.11
	T2	17.54 ± 0.49	17.20 ± 0.34	17.46 ± 0.15	16.08 ± 0.64	15.82 ± 0.64	16.39 ± 0.95
	T3	17.65 ± 0.27	17.52 ± 0.17	17.45 ± 0.09	16.04 ± 0.40	16.03 ± 0.84	16.41 ± 0.87
C1↔C2	T0	15.27 ± 0.25	15.21 ± 0.37	15.22 ± 0.14	14.98 ± 0.23	15.01 ± 0.24	14.90 ± 0.54
	T1	15.59 ± 0.27	15.44 ± 0.38	15.37 ± 0.47	15.12 ± 0.42	15.10 ± 0.37	14.96 ± 0.26
	T2	15.65 ± 0.44	15.48 ± 0.40	15.41 ± 0.38	15.33 ± 0.29	15.36 ± 0.67	15.28 ± 0.54
	T3	15.82 ± 0.63	15.75 ± 0.59	15.66 ± 0.34	15.44 ± 0.59	15.60 ± 0.82	15.48 ± 0.38
Zp1↔Zp2	T0	18.57 ± 0.57	18.80 ± 0.86	18.85 ± 0.17	18.52 ± 0.12	18.77 ± 0.40	19.09 ± 0.23
	T1	19.34 ± 0.31	19.36 ± 0.48	19.65 ± 0.36	18.90 ± 0.38	18.87 ± 0.51	19.29 ± 0.23
	T2	19.99 ± 0.60	19.84 ± 0.57	20.20 ± 0.19	19.35 ± 0.57	19.42 ± 0.44	19.64 ± 0.30
	T3	20.04 ± 0.73	20.18 ± 0.45	20.37 ± 0.13	19.65 ± 0.70	19.73 ± 0.94	19.82 ± 0.39
Cd1↔Cd2	T0	15.68 ± 0.35	15.78 ± 0.36	15.81 ± 0.20	15.73 ± 0.27	15.80 ± 0.26	16.02 ± 0.19
	T1	16.22 ± 0.33	16.16 ± 0.23	16.37 ± 0.16	15.00 ± 0.53	15.00 ± 0.68	15.18 ± 0.88
	T2	16.85 ± 0.45	16.44 ± 0.28	16.76 ± 0.15	15.72 ± 0.54	15.32 ± 0.66	15.71 ± 0.55
	T3	16.62 ± 0.23	16.69 ± 0.44	16.92 ± 0.20	15.73 ± 0.41	15.63 ± 0.74	16.23 ± 0.49
P1↔P2	T0	7.65 ± 0.23	7.71 ± 0.13	7.67 ± 0.14	7.58 ± 0.10	7.63 ± 0.24	7.71 ± 0.17
	T1	7.86 ± 0.18	7.84 ± 0.21	7.76 ± 0.33	7.72 ± 0.52	7.71 ± 0.51	7.72 ± 0.47
	T2	7.96 ± 0.18	7.91 ± 0.17	7.82 ± 0.21	7.99 ± 0.30	8.03 ± 0.63	7.87 ± 0.52
	T3	8.19 ± 0.49	8.15 ± 0.20	7.93 ± 0.09	8.07 ± 0.52	8.20 ± 0.85	7.97 ± 0.24
Za1↔Za2 (mm)	T0	8.90 ± 0.21	8.83 ± 0.29	8.87 ± 0.24	8.80 ± 0.19	9.01 ± 0.21	8.93 ± 0.08
	T1	9.19 ± 0.11	9.07 ± 0.31	9.14 ± 0.22	9.15 ± 0.45	9.19 ± 0.38	9.01 ± 0.25
	T2	9.43 ± 0.15	9.39 ± 0.36	9.39 ± 0.19	9.28 ± 0.12	9.37 ± 0.46	9.29 ± 0.22
	T3	9.49 ± 0.20	9.58 ± 0.19	9.41 ± 0.26	9.38 ± 0.35	9.56 ± 0.72	9.48 ± 0.25
Mx1↔Mx2 (mm)	T0	6.69 ± 0.53	6.99 ± 0.25	6.89 ± 0.19	6.87 ± 0.24	7.15 ± 0.14	7.14 ± 0.12
	T1	7.17 ± 0.29	7.18 ± 0.23	7.41 ± 0.20	7.50 ± 0.69	7.28 ± 0.36	7.38 ± 0.20
	T2	7.49 ± 0.22	7.47 ± 0.19	7.59 ± 0.16	7.60 ± 0.36	7.40 ± 0.27	7.53 ± 0.15
	T3	7.55 ± 0.19	7.72 ± 0.15	7.81 ± 0.50	7.76 ± 0.45	7.59 ± 0.38	7.66 ± 0.19

5.3.1.1 DVC-ST Anteroposterior Projection of Gonial Processes (xGo)

Multiple comparisons within the groups between T0, T1, T2, and T3 for xGo1 and xGo2 are displayed below (Table XXXVI). A line graph of the group means and a boxplot of xGo1 and xGo2 are displayed below in Figures 56 to 59. At T1 the left and right hand side gonial angles (xGo1, xGo2) were positioned significantly more anteriorly in the MB group than the C, B, and S groups ($p \leq 0.001$). This finding was also recorded at T2 and T3 ($p \leq 0.01$).

Table XXXVI: Multiple Comparisons Within Groups DVC-ST for xGo1 and xGo2

Group	Dependent Variable	(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$							Lower	Upper
C	xGo1	0	1	-0.08	0.40	1.00	-1.65	1.50
			2	0.04	0.35	1.00	-1.32	1.40
			3	0.30	0.37	0.96	-1.14	1.75
		1	2	0.12	0.41	1.00	-1.49	1.73
			3	0.38	0.43	0.95	-1.28	2.04
		2	3	0.26	0.38	0.99	-1.22	1.75
	xGo2	0	1	0.20	0.67	1.00	-2.42	2.83
			2	0.08	0.68	1.00	-2.57	2.73
			3	-0.17	0.87	1.00	-3.59	3.25
		1	2	-0.12	0.61	1.00	-2.47	2.23
			3	-0.37	0.81	1.00	-3.67	2.93
		2	3	-0.25	0.82	1.00	-3.56	3.06
B	xGo1	0	1	-0.42	0.35	0.84	-1.93	1.08
			2	-0.40	0.37	0.89	-1.92	1.13
			3	0.12	0.45	1.00	-1.62	1.85
		1	2	0.03	0.25	1.00	-0.94	0.99
			3	0.54	0.35	0.62	-0.93	2.02
		2	3	0.52	0.37	0.71	-0.98	2.01
	xGo2	0	1	-0.16	0.49	1.00	-2.38	2.07
			2	-0.19	0.67	1.00	-2.80	2.42
			3	0.90	0.68	0.75	-1.75	3.56
		1	2	-0.03	0.51	1.00	-2.34	2.27
			3	1.06	0.52	0.38	-1.32	3.44
		2	3	1.09	0.70	0.59	-1.60	3.79
S	xGo1	0	1	0.02	0.32	1.00	-1.24	1.28
			2	-0.30	0.28	0.89	-1.47	0.87
			3	0.12	0.28	1.00	-1.05	1.29
		1	2	-0.31	0.24	0.77	-1.30	0.67
			3	0.10	0.24	1.00	-0.88	1.08
		2	3	0.41	0.17	0.16	-0.24	1.07
	xGo2	0	1	-0.62	0.82	0.98	-3.83	2.60
			2	0.40	0.56	0.98	-2.17	2.97
			3	0.34	0.62	1.00	-2.20	2.88
		1	2	1.02	0.64	0.63	-2.00	4.04
			3	0.96	0.70	0.74	-1.99	3.91
		2	3	-0.06	0.34	1.00	-1.49	1.37
M	xGo1	0	1	-3.77*	0.78	0.01	-7.56	0.02
			2	-2.86*	0.60	0.01	-5.75	0.02
			3	-2.41	0.59	0.03	-5.25	0.43
		1	2	0.91	0.97	0.94	-2.92	4.73
			3	1.36	0.97	0.70	-2.45	5.18
		2	3	0.46	0.83	1.00	-2.76	3.67
	xGo2	0	1	-5.89*	1.19	0.01	-11.49	-0.29
			2	-4.62	1.19	0.03	-10.19	0.95
			3	-4.29	1.32	0.07	-10.57	1.99
		1	2	1.27	1.64	0.97	-5.08	7.62
			3	1.60	1.74	0.94	-5.17	8.36
		2	3	0.33	1.74	1.00	-6.42	7.08
MB	xGo1	0	1	-5.35*	0.81	0.00	-9.16	-1.56
			2	-5.56*	1.04	0.01	-10.56	-0.58
			3	-5.72*	1.11	0.01	-11.03	-0.42
		1	2	-0.21	1.30	1.00	-5.31	4.89
			3	-0.37	1.35	1.00	-5.71	4.97
		2	3	-0.16	1.50	1.00	-5.97	5.65
	xGo2	0	1	-8.75*	1.33	0.00	-15.18	-2.34

			2	-8.45*	1.78	0.01	-17.16	0.26
			3	-8.31	1.97	0.02	-17.95	1.33
		1	2	0.31	2.21	1.00	-8.42	9.03
			3	0.45	2.36	1.00	-9.01	9.91
		2	3	0.14	2.64	1.00	-10.14	10.42
MS	xGo1	0	1	-4.53	1.30	0.06	-10.92	1.85
			2	-3.95	1.00	0.03	-8.82	0.93
			3	-2.15	0.85	0.21	-6.28	1.98
		1	2	0.58	1.63	1.00	-5.85	7.02
			3	2.38	1.55	0.62	-3.85	8.61
		2	3	1.80	1.30	0.72	-3.28	6.88
	xGo2	0	1	-7.08	2.03	0.06	-16.95	2.79
			2	-6.87	1.85	0.04	-15.84	2.10
			3	-4.17	1.70	0.23	-12.42	4.07
		1	2	0.21	2.72	1.00	-10.36	10.78
			3	2.91	2.62	0.87	-7.34	13.16
		2	3	2.70	2.49	0.88	-6.97	12.36

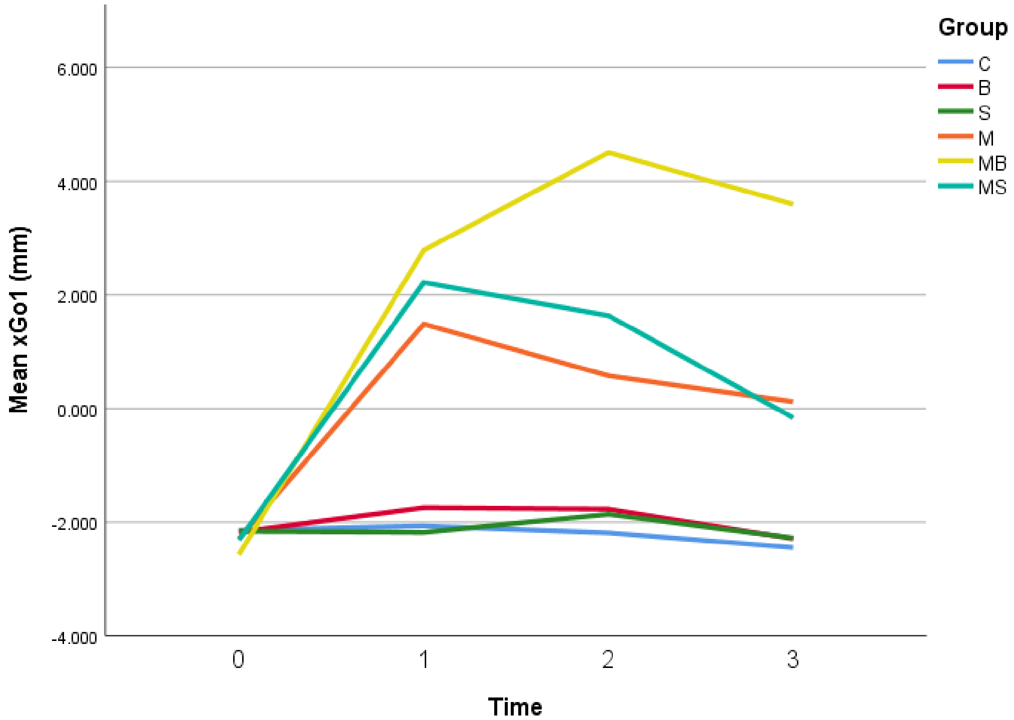


Figure 56: Mean lengths (mm) of xGo1 for DVC-ST groups at timepoints T0 to T3

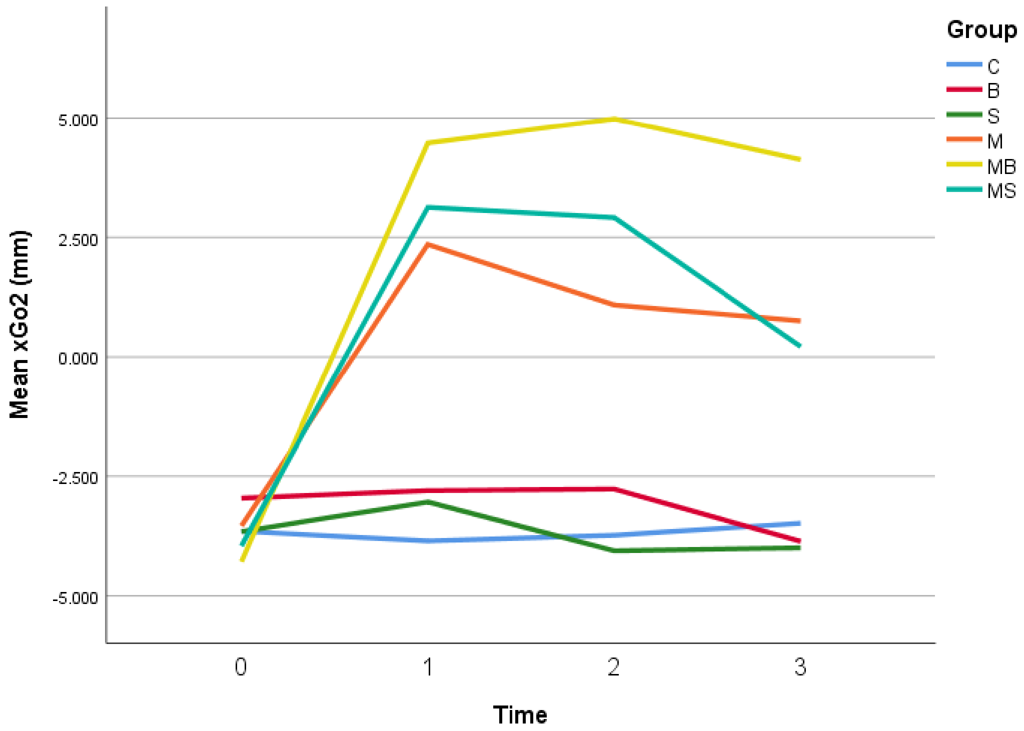


Figure 57: Mean lengths (mm) of xGo2 for DVC-ST groups at timepoints T0 to T3

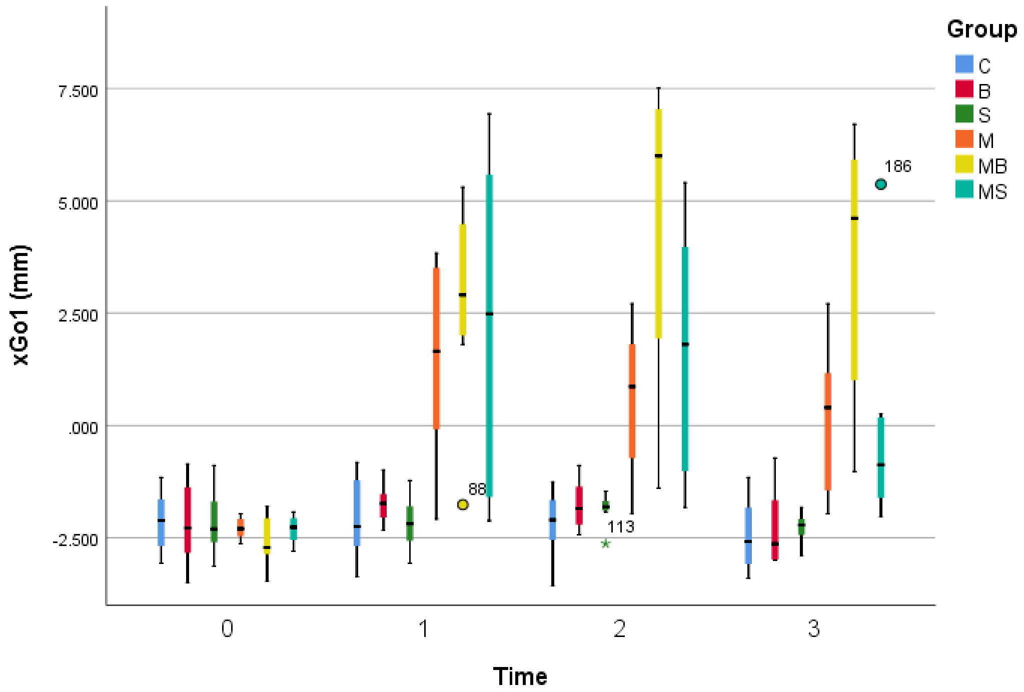


Figure 58: Boxplot of xGo1 (mm) for DVC-ST groups at timepoints T0 to T3

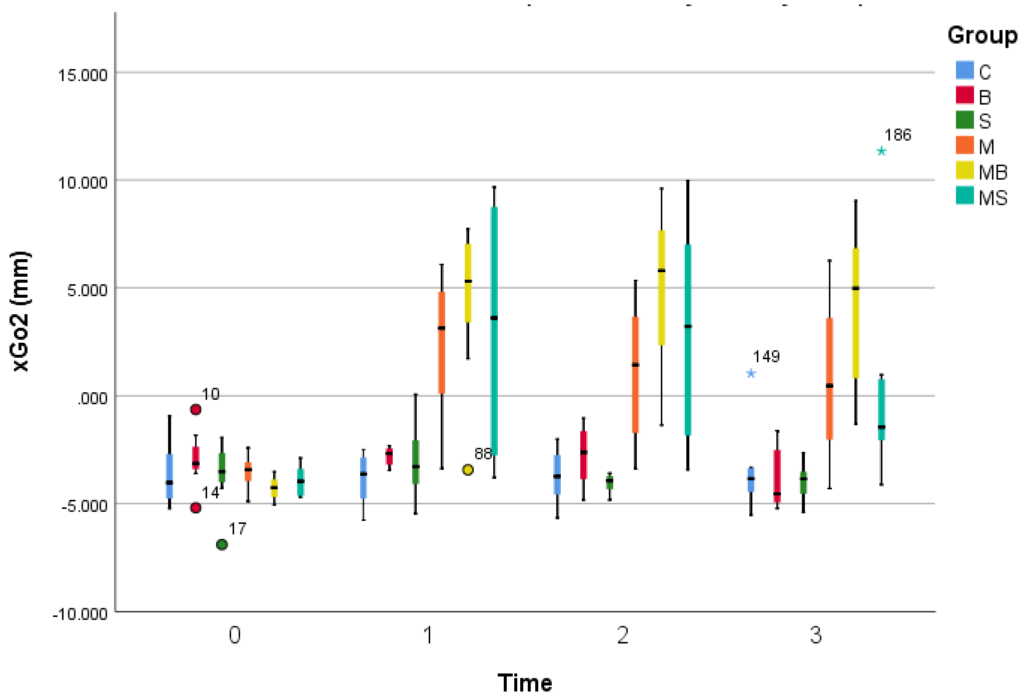


Figure 59: Boxplot of xGo2 (mm) for DVC-ST groups at timepoints T0 to T3

5.3.1.2 DVC-ST Anteroposterior Projection of Coronoid Processes (xCd)

Multiple comparisons within the groups between T0, T1, T2, and T3 for xCd1 and xCd2 are displayed below (Table XXXVII). A line graph of the group means and a boxplot of xCd1 and xCd2 are displayed below in Figures 60 to 64. At T1 to T3 both the left and right hand side coronoid processes (xCd1, xCd2) were positioned significantly ($p \leq 0.01$) more anteriorly in the M, MB, and MS groups than the C, B, and S groups.

Table XXXVII: Multiple Comparisons Within Groups for xCd1 and xCd2

Group	Dependent Variable	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$							Lower	Upper
C	xCd1	0	1	-0.45	0.28	0.57	-1.54	0.64
			2	-0.84	0.29	0.06	-1.95	0.27
			3	-0.71	0.30	0.19	-1.89	0.47
		1	2	-0.39	0.27	0.68	-1.43	0.66
			3	-0.26	0.29	0.94	-1.39	0.87
		2	3	0.12	0.30	1.00	-1.02	1.27
	xCd2	0	1	-0.25	0.46	1.00	-2.17	1.68
			2	-0.56	0.55	0.91	-2.69	1.57
			3	-0.78	0.49	0.58	-2.74	1.18
		1	2	-0.31	0.42	0.98	-2.04	1.42
			3	-0.53	0.34	0.60	-1.87	0.80
		2	3	-0.22	0.45	1.00	-2.00	1.57
B	xCd1	0	1	-0.65	0.44	0.66	-2.38	1.09
			2	-0.99	0.50	0.35	-2.95	0.97
			3	-0.54	0.48	0.86	-2.41	1.32
		1	2	-0.34	0.45	0.98	-2.12	1.44

			3	0.10	0.42	1.00	-1.55	1.76
		2	3	0.45	0.49	0.94	-1.46	2.35
	xCd2	0	1	-1.04	0.63	0.54	-3.53	1.44
			2	-1.65	0.67	0.16	-4.27	0.97
			3	-0.71	0.61	0.84	-3.13	1.71
		1	2	-0.60	0.59	0.90	-2.91	1.70
			3	0.33	0.51	0.99	-1.65	2.32
		2	3	0.94	0.56	0.54	-1.28	3.16
S	xCd1	0	1	-0.50	0.39	0.78	-2.07	1.06
			2	-0.75	0.41	0.43	-2.35	0.85
			3	-0.59	0.35	0.54	-2.11	0.93
		1	2	-0.24	0.34	0.98	-1.55	1.06
			3	-0.09	0.26	1.00	-1.16	0.98
		2	3	0.16	0.28	1.00	-1.02	1.33
	xCd2	0	1	-1.15	0.74	0.61	-4.04	1.74
			2	-1.06	0.58	0.48	-3.67	1.56
			3	-0.51	0.58	0.95	-3.13	2.11
		1	2	0.10	0.53	1.00	-2.28	2.48
			3	0.64	0.53	0.83	-1.74	3.02
		2	3	0.54	0.25	0.24	-0.41	1.50
M	xCd1	0	1	-3.85*	0.71	0.01	-7.30	-0.42
			2	-2.76*	0.53	0.01	-5.30	-0.22
			3	-2.02	0.53	0.04	-4.57	0.53
		1	2	1.10	0.88	0.80	-2.36	4.56
			3	1.84	0.88	0.30	-1.63	5.30
		2	3	0.74	0.74	0.91	-2.13	3.61
	xCd2	0	1	-5.12*	1.10	0.01	-10.07	-0.17
			2	-3.41*	0.67	0.00	-6.14	-0.69
			3	-3.18*	0.77	0.01	-6.43	0.07
		1	2	1.70	1.19	0.70	-3.22	6.62
			3	1.94	1.25	0.61	-3.08	6.95
		2	3	0.24	0.90	1.00	-3.26	3.74
MB	xCd1	0	1	-4.23*	0.64	0.00	-7.12	-1.36
			2	-4.77*	0.90	0.01	-9.02	-0.52
			3	-5.06*	0.94	0.01	-9.52	-0.62
		1	2	-0.53	1.07	1.00	-4.80	3.74
			3	-0.83	1.10	0.98	-5.26	3.60
		2	3	-0.30	1.27	1.00	-5.24	4.65
	xCd2	0	1	-5.36*	0.98	0.00	-9.64	-1.09
			2	-5.48*	1.01	0.00	-9.95	-1.02
			3	-5.34*	0.96	0.00	-9.56	-1.13
		1	2	-0.12	1.31	1.00	-5.19	4.95
			3	0.02	1.27	1.00	-4.91	4.95
		2	3	0.14	1.30	1.00	-4.90	5.18
MS	xCd1	0	1	-4.17	1.25	0.07	-10.29	1.95
			2	-3.42	0.97	0.05	-8.14	1.30
			3	-1.91	0.53	0.04	-4.39	0.57
		1	2	0.75	1.57	1.00	-5.44	6.94
			3	2.25	1.35	0.56	-3.62	8.13
		2	3	1.51	1.09	0.73	-3.04	6.06
	xCd2	0	1	-4.67	1.10	0.02	-9.87	0.54
			2	-4.48*	0.94	0.01	-8.85	-0.11
			3	-2.74	0.85	0.07	-6.66	1.18
		1	2	0.19	1.41	1.00	-5.32	5.69
			3	1.93	1.35	0.69	-3.41	7.26
		2	3	1.74	1.23	0.69	-3.02	6.50

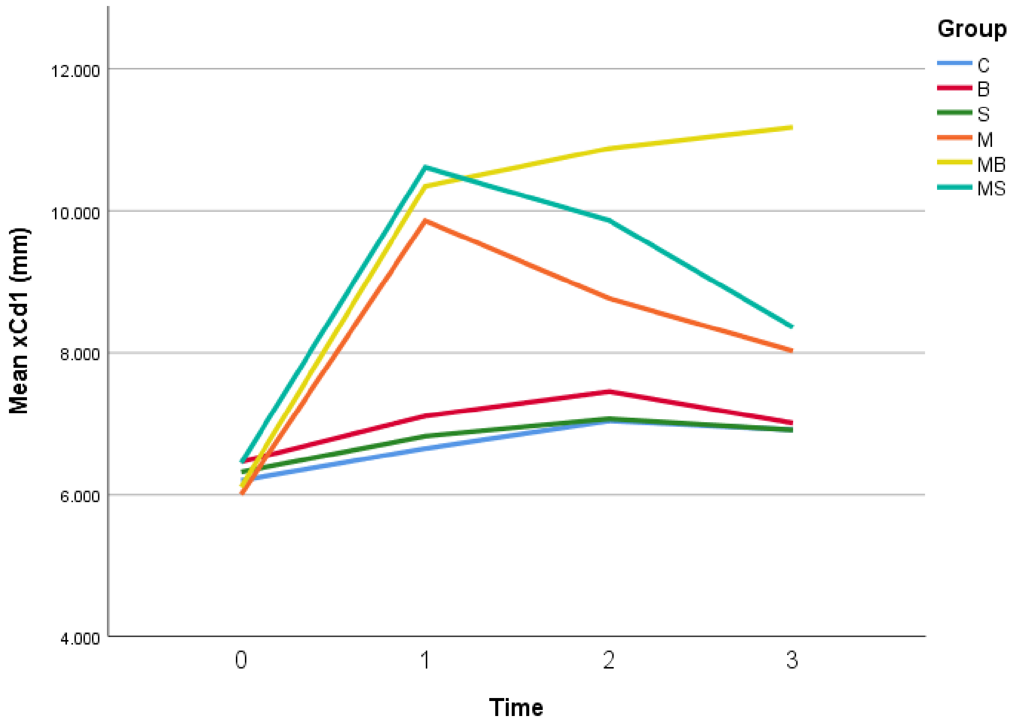


Figure 60: Mean lengths (mm) of xCd1 for DVC-ST groups at timepoints T0 to T3

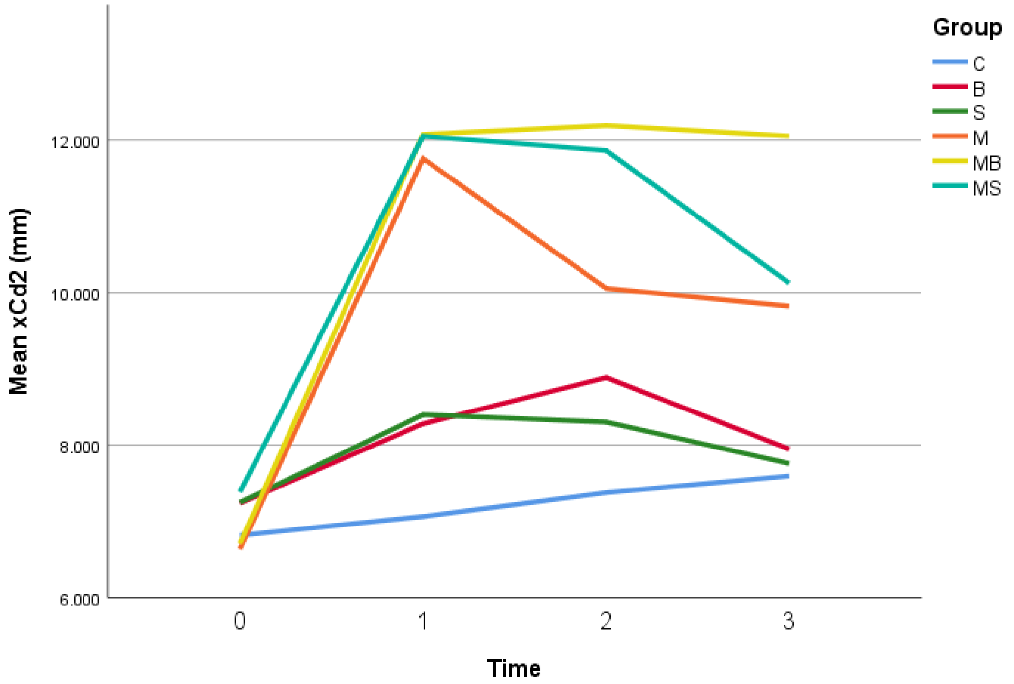


Figure 61: Mean lengths (mm) of xCd2 for DVC-ST groups at timepoints T0 to T3

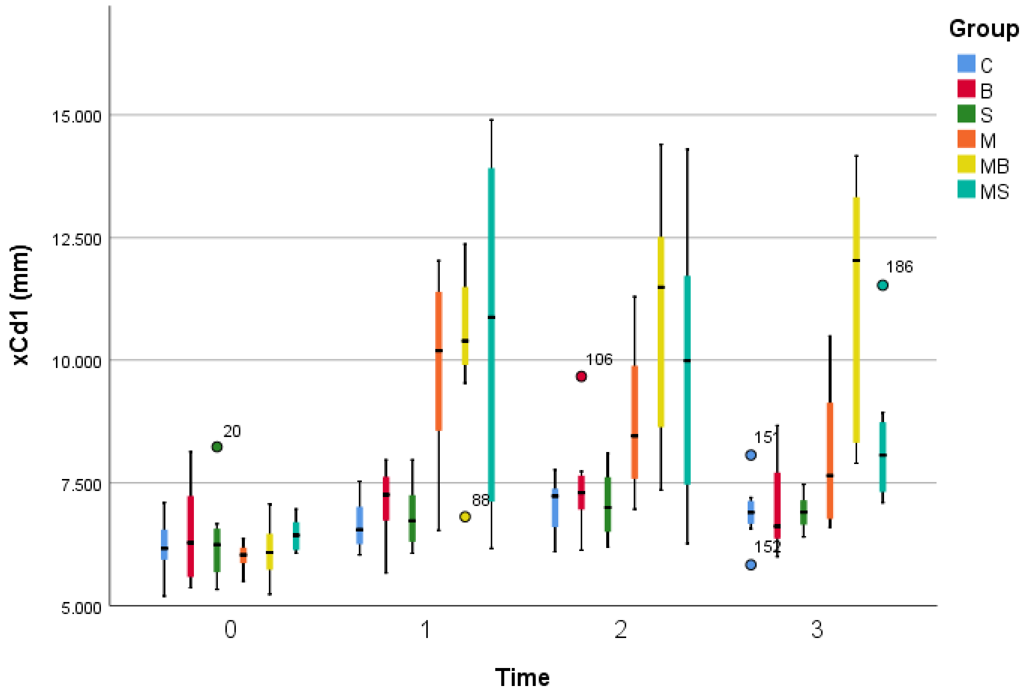


Figure 62: Boxplot of xCd1 (mm) for DVC-ST groups at timepoints T0 to T3

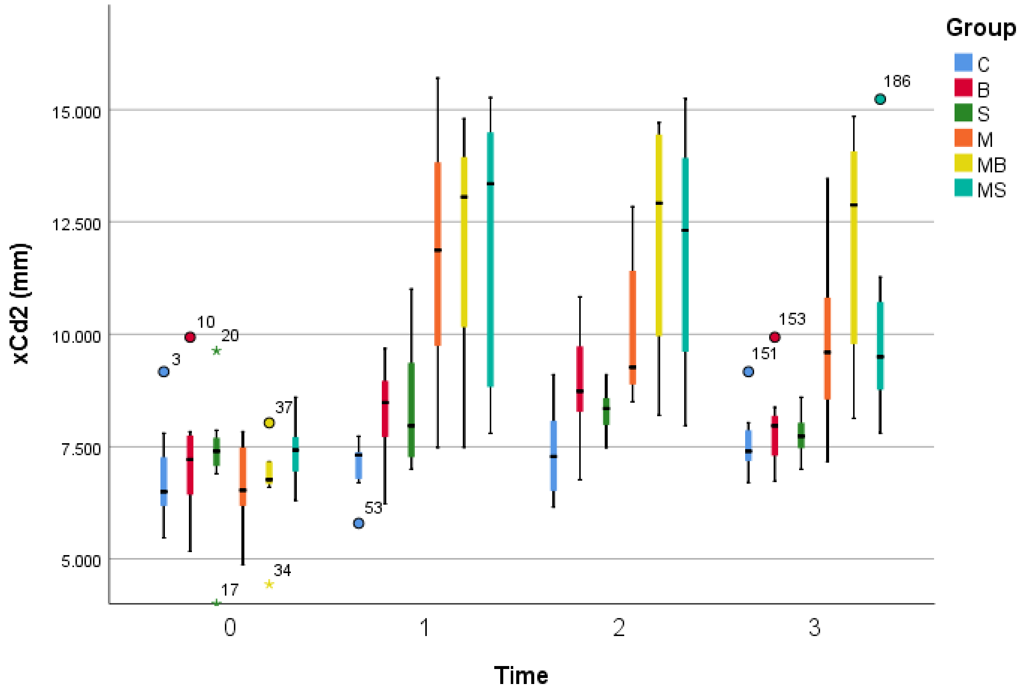


Figure 63: Boxplot of xCd2 (mm) for DVC-ST groups at timepoints T0 to T3

5.3.1.3 DVC-ST Intergonial Widths

Multiple comparisons within the groups between T0, T1, T2, and T3 for intergonial widths are displayed below (Table XXXVIII). A line graph of the group means and a boxplot of Go1↔Go2 are displayed below in Figures 64 and 65. At T1 the M group had significantly narrower intergonial (Go1↔Go2) widths ($p \leq 0.01$) than the C, B, and S groups. The MB group had significantly narrower intergonial (Go1↔Go2) widths than the S group ($p \leq 0.01$). At T2 the M group had significantly narrower intergonial (Go1↔Go2) widths ($p \leq 0.01$) than the C and S groups. The MB group had significantly narrower intergonial (Go1↔Go2) widths than the C, B, and S groups ($p \leq 0.01$). At T3 the M group had significantly narrower intergonial (Go1↔Go2) widths than the C, B, and S groups ($p \leq 0.001$). There was a general trend for the appliance groups to have narrower intergonial widths from T1 to T3.

Table XXXVIII: Multiple Comparisons Within Groups for Go1 to Go2

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower Bound	Upper Bound
C	0	1	-0.33	0.17	0.38	-1.00	0.35
		2	-0.71	0.20	0.03	-1.53	0.12
		3	-0.82*	0.14	0.00	-1.35	-0.29
	1	2	-0.38	0.22	0.51	-1.25	0.49
		3	-0.49	0.17	0.07	-1.16	0.18
	2	3	-0.11	0.20	0.99	-0.94	0.71
B	0	1	-0.16	0.18	0.96	-0.92	0.61
		2	-0.24	0.20	0.84	-1.03	0.56
		3	-0.56	0.17	0.06	-1.33	0.20
	1	2	-0.08	0.14	1.00	-0.66	0.49
		3	-0.40*	0.10	0.01	-0.80	-0.01
	2	3	-0.32	0.13	0.20	-0.89	0.24
S	0	1	-0.46*	0.05	0.00	-0.66	-0.27
		2	0-.58*	0.07	0.00	-0.84	-0.32
		3	-0.56*	0.05	0.00	-0.76	-0.38
	1	2	-0.12	0.06	0.39	-0.38	0.13
		3	-0.10	0.05	0.20	-0.28	0.07
	2	3	0.02	0.06	1.00	-0.24	0.27
M	0	1	0.97	0.22	0.02	-0.10	2.03
		2	0.60	0.23	0.18	-0.49	1.69
		3	0.64*	0.15	0.01	-0.03	1.31
	1	2	-0.37	0.31	0.84	-1.58	0.85
		3	-0.33	0.26	0.80	-1.38	0.73
	2	3	0.04	0.26	1.00	-1.03	1.11
MB	0	1	1.31	0.35	0.02	-0.16	2.77
		2	1.04*	0.27	0.01	-0.05	2.14
		3	0.83	0.33	0.17	-0.56	2.23
	1	2	-0.26	0.39	0.99	-1.79	1.26
		3	-0.47	0.43	0.87	-2.14	1.19
	2	3	-0.21	0.37	1.00	-1.68	1.26
MS	0	1	1.01	0.41	0.21	-0.87	2.89
		2	0.77	0.35	0.31	-0.83	2.36
		3	0.75	0.33	0.25	-0.70	2.21
	1	2	-0.24	0.52	1.00	-2.25	1.77
		3	-0.26	0.50	1.00	-2.21	1.70
	2	3	-0.01	0.45	1.00	-1.78	1.75

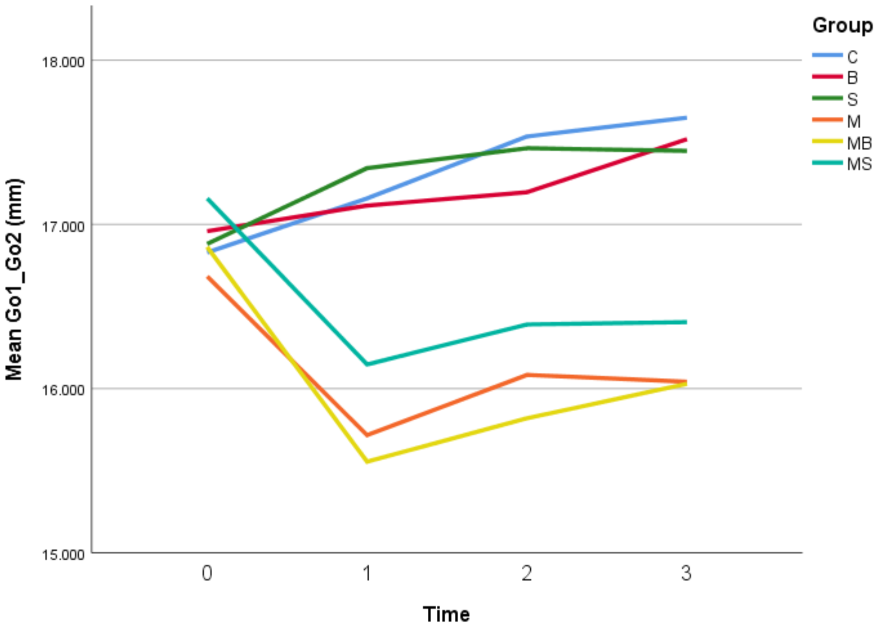


Figure 64: Mean lengths (mm) of Go1↔Go2 for DVC-ST groups at timepoints T0 to T7

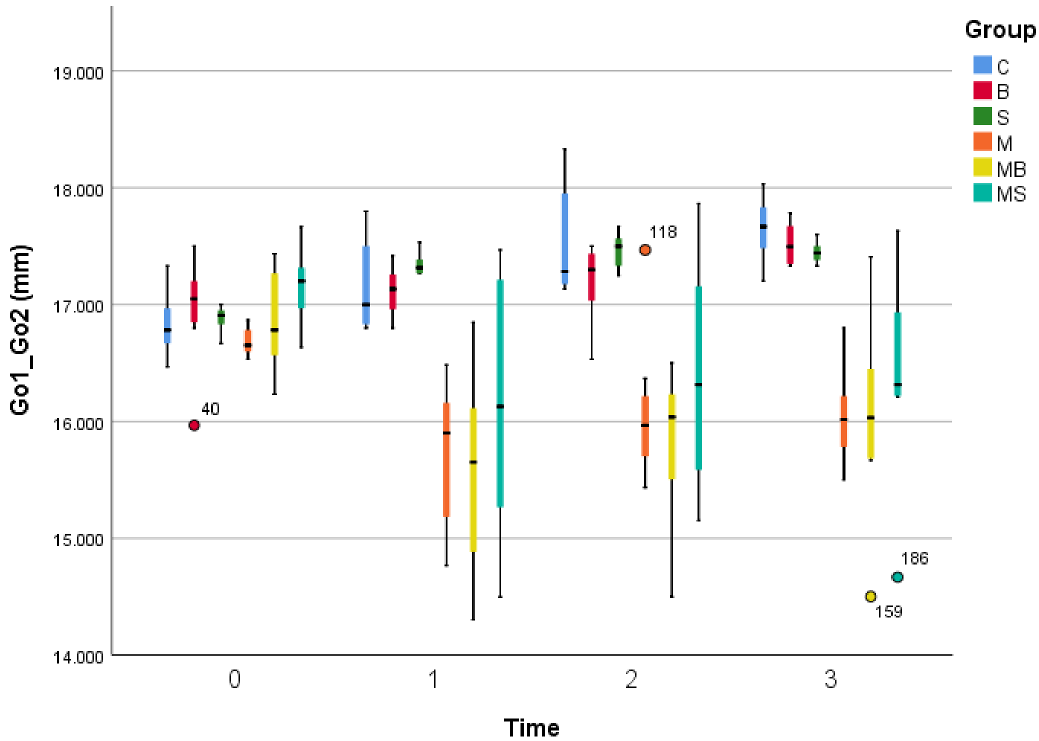


Figure 65: Boxplot (mm) of Go1↔Go2 for DVC-ST groups at timepoints T0 to T3

5.3.1.4 DVC-ST Intercoronoid Widths

Multiple comparisons within the groups between T0, T1, T2, and T3 for intercoronoid widths are displayed below (Table XXXIX). A line graph of the group means and a boxplot of Cd1↔Cd2 are displayed below in Figures 66 and 67. At T1 the M group had significantly narrower intercoronoid (Cd1↔Cd2) widths ($p \leq 0.01$) than the C, B, and S groups. The MB group had significantly narrower intercoronoid (Cd1↔Cd2) widths than the S group ($p \leq 0.01$). At T2 the M group had significantly narrower intercoronoid (Cd1↔Cd2) widths ($p \leq 0.01$) than the C and S groups. The MB group had significantly narrower intercoronoid (Cd1↔Cd2) widths than the S group ($p \leq 0.01$). At T3 M group had significantly narrower intercoronoid (Cd1↔Cd2) widths ($p \leq 0.01$) than the C, B, and S groups ($p \leq 0.01$). There was a general trend for the appliance groups to have narrower intercoronoid widths.

Table XXXIX: Multiple Comparisons Within Groups for Cd1 to Cd2

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper
C	0	1	-0.54	0.17	0.04	-1.19	0.11
		2	-1.16*	0.20	0.00	-1.95	-0.38
		3	-0.94*	0.15	0.00	-1.53	-0.35
	1	2	-0.63	0.20	0.04	-1.40	0.15
		3	-0.40	0.14	0.09	-0.96	0.17
	2	3	0.23	0.18	0.78	-0.52	0.98
B	0	1	-0.38	0.15	0.16	-0.98	0.23
		2	-0.65*	0.16	0.01	-1.28	-0.02
		3	-0.91*	0.20	0.00	-1.69	-0.13
	1	2	-0.28	0.13	0.26	-0.78	0.23
		3	-0.53	0.18	0.07	-1.26	0.20
	2	3	-0.26	0.18	0.71	-1.00	0.49
S	0	1	-0.56*	0.09	0.00	-0.92	-0.20
		2	-0.95*	0.09	0.00	-1.30	-0.60
		3	-1.11*	0.10	0.00	-1.51	-0.73
	1	2	-0.39*	0.08	0.00	-0.70	-0.08
		3	-0.56*	0.09	0.00	-0.92	-0.20
	2	3	-0.17	0.09	0.40	-0.52	0.18
M	0	1	0.73	0.21	0.04	-0.16	1.62
		2	0.01	0.21	1.00	-0.89	0.91
		3	0.00	0.17	1.00	-0.70	0.70
	1	2	-0.72	0.27	0.10	-1.76	0.32
		3	-0.73	0.24	0.05	-1.67	0.21
	2	3	-0.01	0.24	1.00	-0.96	0.93
MB	0	1	0.80	0.26	0.07	-0.34	1.94
		2	0.48	0.25	0.43	-0.63	1.59
		3	0.18	0.28	0.99	-1.07	1.42
	1	2	-0.32	0.34	0.93	-1.62	0.98
		3	-0.62	0.36	0.48	-2.00	0.76
	2	3	-0.30	0.35	0.96	-1.67	1.07
MS	0	1	0.84	0.32	0.17	-0.66	2.34
		2	0.31	0.21	0.66	-0.61	1.23
		3	-0.20	0.18	0.89	-1.01	0.61
	1	2	-0.53	0.37	0.69	-2.01	0.96
		3	-1.04	0.35	0.08	-2.51	0.43
	2	3	-0.51	0.26	0.34	-1.52	0.49

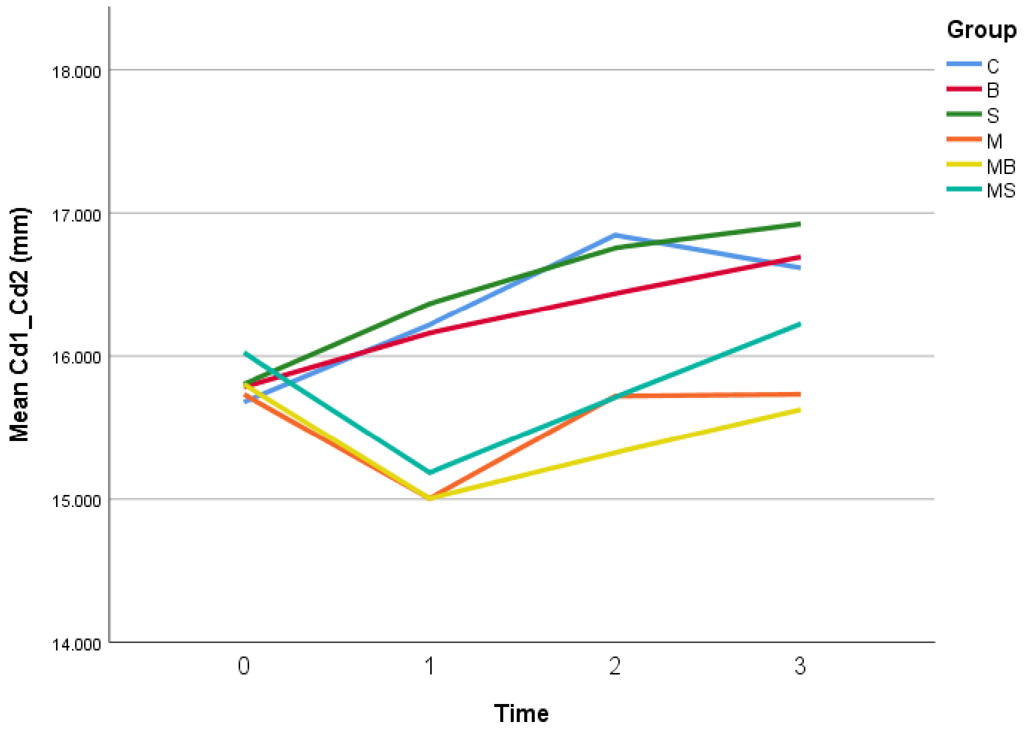


Figure 66: Line graph of Cd1↔Cd2 (mm) for DVC-ST groups at timepoints T0 to T3

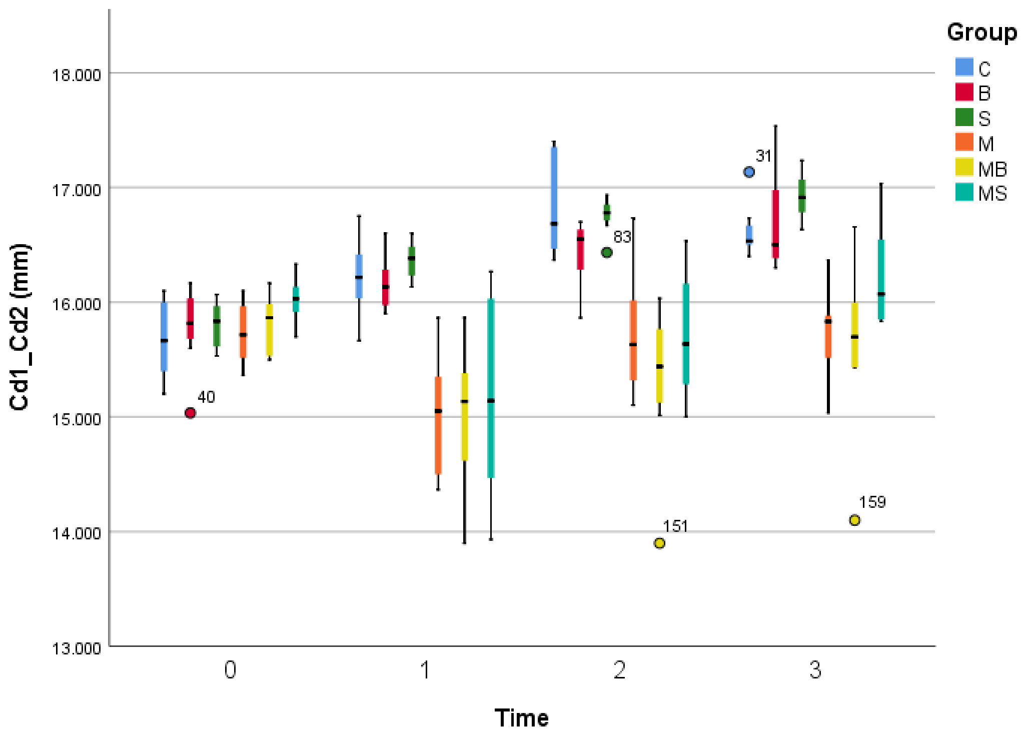


Figure 67: Boxplot of Cd1↔Cd2 (mm) for DVC-ST groups at timepoints T0 to T3

5.3.2 Long-term Dorsoventral Cephalometric Results

The means and standard deviations (SD) for the long-term (LT) Dorsoventral Cephalometric (DVC) groups are displayed below in Table XL. Boxplots for those variables without significant findings can be referred to in Appendix 5.

Table XL: Means and Standard Deviations for the DVC-LT Groups

Variable	Time	CL	BL	BLR	SL	SLR	ML	MBL	MBLR	MSL	MSLR
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Between Groups Comparison significance: significant p ≤ 0.01, highly significant p ≤ 0.001											
O↔N (mm)	T0	32.30 ± 0.94	31.19 ± 1.69	31 ± 0.92	30.50 ± 1.54	31.22 ± 2.14	32.99 ± 1.46	32.99 ± 0.61	33.60 ± 1.07	33.65 ± 1.17	33.36 ± 0.98
	T1	33.15 ± 0.65	32.81 ± 1.49	33 ± 0.87	32.10 ± 2.02	33.46 ± 1.38	34.46 ± 1.13	33.61 ± 1.39	34.86 ± 0.53	34.29 ± 0.72	34.34 ± 1.15
	T2	35.33 ± 0.88	33.96 ± 1.29	34 ± 0.97	34.38 ± 0.99	34.26 ± 0.80	34.71 ± 1.55	35.58 ± 1.77	35.39 ± 0.39	34.58 ± 1.16	34.48 ± 0.84
	T3	36.30 ± 0.87	34.98 ± 1.12	35 ± 1.17	35.64 ± 1.10	35.03 ± 1.22	35.54 ± 1.81	35.94 ± 1.61	36.17 ± 0.72	35.18 ± 0.66	35.00 ± 1.02
	T4	36.96 ± 1.47	36.84 ± 1.19	36 ± 0.73	35.89 ± 1.41	36.44 ± 0.83	36.00 ± 1.45	36.36 ± 1.73	36.71 ± 1.03	35.83 ± 0.32	36.43 ± 1.25
	T5	39.47 ± 0.96	37.03 ± 1.82	37 ± 1.37	37.86 ± 1.65	37.70 ± 1.11	37.35 ± 1.19	38.22 ± 0.84	38.10 ± 0.73	38.25 ± 0.77	37.56 ± 1.18
	T6	41.19 ± 1.12	38.80 ± 1.01	39 ± 0.79	39.74 ± 1.74	39.58 ± 2.20	39.47 ± 1.21	40.60 ± 1.39	40.02 ± 0.92	39.96 ± 1.19	38.98 ± 1.71
	T7	42.17 ± 0.81	40.33 ± 1.56	41 ± 1.00	41.10 ± 0.90	40.42 ± 1.62	41.03 ± 0.70	41.62 ± 1.07	41.22 ± 0.87	41.67 ± 0.51	40.47 ± 1.37
CBL (mm)	T0	5.09 ± 0.32	5.07 ± 0.15	5 ± 0.33	4.75 ± 0.30	5.10 ± 0.27	5.09 ± 0.24	5.18 ± 0.31	5.02 ± 0.32	4.91 ± 0.29	4.78 ± 0.23
	T1	5.57 ± 0.34	5.29 ± 0.21	5 ± 0.22	5.29 ± 0.22	5.60 ± 0.21	5.52 ± 0.38	5.59 ± 0.33	5.51 ± 0.18	5.44 ± 0.23	5.48 ± 0.26
	T2	5.89 ± 0.44	5.71 ± 0.31	5 ± 0.17	5.76 ± 0.29	5.96 ± 0.15	5.78 ± 0.27	5.86 ± 0.32	5.89 ± 0.20	5.66 ± 0.27	5.63 ± 0.25
	T3	6.04 ± 0.28	5.90 ± 0.34	6 ± 0.29	6.04 ± 0.20	6.37 ± 0.19	6.04 ± 0.18	6.16 ± 0.37	6.15 ± 0.21	6.06 ± 0.17	5.86 ± 0.22
	T4	6.33 ± 0.48	6.62 ± 0.15	6 ± 0.31	6.35 ± 0.41	6.60 ± 0.29	6.35 ± 0.32	6.31 ± 0.22	6.39 ± 0.17	6.35 ± 0.23	6.19 ± 0.28
	T5	7.23 ± 0.50	6.88 ± 0.38	6 ± 0.29	6.80 ± 0.28	6.83 ± 0.27	6.96 ± 0.39	6.87 ± 0.27	6.84 ± 0.60	7.00 ± 0.30	6.74 ± 0.29
	T6	7.56 ± 0.75	7.25 ± 0.40	7 ± 0.49	7.25 ± 0.52	7.30 ± 0.33	7.60 ± 0.30	7.93 ± 0.42	7.24 ± 0.46	7.53 ± 0.29	7.22 ± 0.46
	T7	8.08 ± 0.34	7.81 ± 0.22	8 ± 0.31	8.14 ± 0.30	7.94 ± 0.53	8.31 ± 0.45	8.38 ± 0.30	7.99 ± 0.40	8.31 ± 0.50	7.62 ± 0.38
Zp1↔Za1 (mm)	T0	15.01 ± 0.27	14.51 ± 1.08	14 ± 0.48	14.16 ± 0.92	14.54 ± 1.22	15.06 ± 0.80	15.27 ± 0.37	15.48 ± 0.62	15.71 ± 0.53	15.40 ± 0.51
	T1	15.77 ± 0.37	15.24 ± 0.91	15 ± 0.62	15.34 ± 0.92	15.64 ± 1.00	15.24 ± 0.63	15.56 ± 0.32	15.94 ± 0.71	15.90 ± 0.75	15.85 ± 0.89

	T2	16.63 ± 0.35	15.96 ± 0.77	16 ± 0.45	16.27 ± 0.40	16.32 ± 0.39	15.64 ± 0.79	16.18 ± 0.39	16.54 ± 0.70	16.40 ± 0.43	16.09 ± 0.50
	T3	17.23 ± 0.35	16.39 ± 0.53	16 ± 0.50	16.85 ± 0.47	16.73 ± 0.57	15.91 ± 0.65	16.83 ± 0.39	16.87 ± 0.50	16.62 ± 0.62	16.23 ± 0.60
	T4	17.84 ± 0.65	17.12 ± 0.65	16 ± 0.54	17.41 ± 0.62	17.55 ± 0.50	16.65 ± 0.58	16.73 ± 0.51	16.86 ± 0.60	16.75 ± 0.41	16.69 ± 0.81
	T5	18.95 ± 0.48	17.30 ± 0.84	17 ± 0.80	18.47 ± 0.56	18.18 ± 0.68	16.69 ± 0.64	17.38 ± 0.37	17.24 ± 0.35	17.92 ± 0.43	17.28 ± 0.77
	T6	19.84 ± 0.52	18.13 ± 0.78	18 ± 0.63	19.20 ± 0.75	19.50 ± 0.87	18.00 ± 0.71	19.29 ± 0.80	18.32 ± 0.71	18.69 ± 0.71	18.05 ± 0.81
	T7	20.87 ± 0.54	18.87 ± 0.83	19 ± 0.60	20.18 ± 0.65	19.73 ± 0.50	18.79 ± 0.66	19.39 ± 0.63	19.26 ± 0.63	19.46 ± 0.60	18.71 ± 0.68
Zp2↔Za2 (mm)	T0	14.82 ± 0.38	14.40 ± 1.00	14 ± 0.44	14.33 ± 0.88	14.49 ± 1.18	15.08 ± 0.73	15.20 ± 0.26	15.27 ± 0.65	15.55 ± 0.51	15.49 ± 0.36
	T1	15.67 ± 0.40	15.14 ± 0.92	15 ± 0.48	14.87 ± 1.12	15.65 ± 0.95	15.45 ± 0.70	15.47 ± 0.59	15.78 ± 0.56	16.12 ± 0.63	15.91 ± 0.51
	T2	16.50 ± 0.27	15.66 ± 0.82	15 ± 0.38	16.34 ± 0.62	16.23 ± 0.43	15.67 ± 0.52	16.30 ± 0.68	16.16 ± 0.45	16.15 ± 0.74	15.98 ± 0.40
	T3	16.83 ± 0.51	16.21 ± 0.61	16 ± 0.57	16.74 ± 0.57	16.80 ± 0.42	15.87 ± 0.54	16.74 ± 0.66	16.69 ± 0.30	16.42 ± 0.56	16.11 ± 0.53
	T4	17.43 ± 0.54	16.95 ± 0.67	16 ± 0.64	17.24 ± 0.45	17.40 ± 0.45	16.63 ± 0.47	16.89 ± 0.63	16.77 ± 0.52	16.68 ± 0.28	16.57 ± 0.92
	T5	18.56 ± 0.49	17.10 ± 0.95	17 ± 0.72	18.08 ± 0.55	17.89 ± 0.59	16.70 ± 0.59	17.24 ± 0.33	16.94 ± 0.47	17.75 ± 0.31	16.96 ± 0.84
	T6	19.41 ± 0.41	17.82 ± 0.85	17 ± 0.69	18.92 ± 0.62	19.06 ± 0.73	17.64 ± 0.77	19.08 ± 0.91	18.29 ± 0.61	18.59 ± 0.60	17.55 ± 1.10
	T7	20.07 ± 0.61	18.56 ± 1.07	19 ± 0.80	20.06 ± 0.48	19.63 ± 0.66	18.75 ± 0.35	19.27 ± 1.08	18.83 ± 0.55	19.40 ± 0.42	18.52 ± 1.03
xGo1 (mm)	T0	-2.48 ± 0.61	-1.96 ± 0.66	-2 ± 0.63	-2.43 ± 0.62	-2.48 ± 0.74	-2.28 ± 0.55	-2.79 ± 0.53	-2.39 ± 0.58	-2.21 ± 0.57	-1.67 ± 0.42
	T1	-2.44 ± 0.77	-2.30 ± 0.57	-2 ± 0.64	-2.27 ± 0.72	-2.41 ± 0.44	0.19 ± 2.06	1.48 ± 1.65	2.62 ± 1.19	3.53 ± 2.64	1.80 ± 2.64
	T2	-2.40 ± 0.38	-1.82 ± 0.41	-1 ± 0.68	-2.54 ± 0.52	-2.24 ± 0.75	0.47 ± 2.07	1.98 ± 2.04	2.57 ± 1.29	0.33 ± 1.49	0.68 ± 1.27
	T3	-2.58 ± 0.48	-1.38 ± 1.07	-1 ± 0.61	-2.44 ± 0.57	-2.24 ± 0.49	0.01 ± 1.56	1.66 ± 2.09	1.81 ± 1.11	-0.54 ± 1.53	0.22 ± 1.46
	T4	-2.58 ± 0.98	-2.05 ± 1.00	-1 ± 0.74	-2.44 ± 0.33	-2.43 ± 0.28	-0.88 ± 1.71	-0.88 ± 0.62	-0.33 ± 1.58	-1.78 ± 0.92	-1.88 ± 1.36
	T5	-3.45 ± 0.48	-2.14 ± 0.74	-2 ± 1.17	-2.61 ± 0.43	-2.55 ± 0.28	-0.76 ± 1.63	-1.16 ± 0.91	-0.82 ± 1.03	-2.31 ± 0.55	-2.44 ± 0.57
	T6	-3.26 ± 0.70	-2.74 ± 0.65	-3 ± 0.96	-3.22 ± 0.31	-2.60 ± 0.60	-1.98 ± 1.41	-1.64 ± 0.85	-2.35 ± 0.69	-2.65 ± 0.69	-2.36 ± 0.46
	T7	-3.04 ± 1.08	-3.13 ± 0.62	-3 ± 0.66	-3.55 ± 0.67	-3.25 ± 0.81	-2.87 ± 0.96	-1.98 ± 0.60	-3.00 ± 0.57	-2.80 ± 0.49	-2.51 ± 0.82
xGo2 (mm)	T0	-2.79 ± 0.94	-2.38 ± 0.72	-2 ± 0.80	-2.92 ± 0.55	-3.48 ± 0.87	-3.13 ± 1.71	-3.37 ± 0.37	-3.11 ± 0.45	-3.08 ± 0.95	-2.50 ± 0.41
	T1	-3.33 ± 0.82	-3.04 ± 0.83	-2 ± 0.94	-3.16 ± 0.82	-3.43 ± 0.20	0.66 ± 3.08	1.98 ± 2.44	4.31 ± 1.66	4.74 ± 3.44	2.77 ± 3.82
	T2	-3.31 ± 0.65	-2.37 ± 0.62	-1 ± 0.80	-3.66 ± 0.83	-3.19 ± 0.91	1.26 ± 3.21	2.54 ± 3.04	4.42 ± 2.09	0.42 ± 1.80	0.71 ± 1.41
	T3	-3.30 ± 0.94	-2.08 ± 1.33	-2 ± 1.50	-3.32 ± 0.50	-3.52 ± 0.51	-0.08 ± 1.85	1.95 ± 3.04	2.54 ± 1.13	0.54 ± 1.55	0.36 ± 1.43
	T4	-3.23 ± 1.03	-2.53 ± 1.15	-1 ± 0.64	-3.24 ± 0.68	-3.25 ± 0.84	-1.05 ± 2.01	-1.50 ± 0.64	-0.73 ± 1.82	-1.90 ± 1.27	-2.31 ± 1.53
	T5	-4.15 ± 0.79	-3.41 ± 1.19	-3 ± 0.88	-3.19 ± 0.73	-3.18 ± 1.01	-0.63 ± 1.97	-1.02 ± 1.21	-0.81 ± 1.40	-2.61 ± 0.86	-3.05 ± 0.67

	T6	-3.98 ± 1.27	-3.06 ± 0.63	-3 ± 1.36	-3.84 ± 0.88	-3.59 ± 0.98	-1.75 ± 1.56	-2.67 ± 1.76	-3.14 ± 1.09	-3.21 ± 0.69	-3.19 ± 0.86
	T7	-3.64 ± 1.42	-4.00 ± 1.65	-3 ± 0.31	-4.52 ± 0.58	-3.90 ± 1.16	-3.76 ± 1.83	-2.90 ± 1.86	-3.71 ± 0.94	-4.16 ± 1.09	-2.89 ± 1.41
xCd1 (mm)	T0	5.77 ± 0.57	5.72 ± 0.65	5 ± 0.50	5.32 ± 0.80	5.27 ± 0.65	5.82 ± 0.62	5.65 ± 0.48	5.91 ± 0.45	6.24 ± 0.82	6.83 ± 0.29
	T1	6.09 ± 0.63	5.91 ± 0.64	6 ± 0.79	6.16 ± 0.88	6.13 ± 0.79	8.54 ± 2.35	9.38 ± 1.26	10.94 ± 1.21	11.69 ± 2.95	10.79 ± 2.45
	T2	6.53 ± 0.51	6.51 ± 0.56	6 ± 0.92	6.41 ± 0.54	6.60 ± 0.82	8.57 ± 1.91	10.30 ± 2.12	10.46 ± 1.17	12.06 ± 3.76	8.19 ± 1.93
	T3	6.77 ± 0.47	7.31 ± 1.13	6 ± 1.16	6.82 ± 0.43	6.90 ± 0.75	8.90 ± 1.81	10.30 ± 1.93	11.17 ± 1.21	7.10 ± 0.56	7.90 ± 1.60
	T4	6.90 ± 0.80	7.30 ± 1.13	7 ± 1.40	7.05 ± 0.25	6.97 ± 0.32	7.45 ± 1.68	7.02 ± 0.73	8.24 ± 1.89	7.49 ± 0.37	6.93 ± 0.85
	T5	6.81 ± 0.42	7.77 ± 0.49	6 ± 1.51	7.17 ± 0.29	7.15 ± 0.38	7.96 ± 1.81	7.10 ± 0.73	6.92 ± 0.65	7.33 ± 0.73	6.68 ± 0.54
	T6	6.70 ± 0.93	7.30 ± 0.51	7 ± 0.57	6.87 ± 0.30	7.56 ± 0.47	6.95 ± 1.14	7.09 ± 0.84	6.67 ± 0.81	7.44 ± 0.68	6.83 ± 0.85
	T7	6.76 ± 1.04	7.05 ± 0.56	7 ± 0.88	7.01 ± 0.47	7.54 ± 0.85	6.55 ± 0.92	6.76 ± 0.89	7.09 ± 0.71	7.23 ± 0.46	7.37 ± 0.78
xCd2 (mm)	T0	5.40 ± 0.58	5.09 ± 0.76	5 ± 0.54	4.59 ± 0.91	4.73 ± 0.32	5.14 ± 0.66	5.28 ± 0.19	5.43 ± 0.42	5.49 ± 0.96	6.29 ± 0.54
	T1	5.73 ± 0.53	5.48 ± 0.81	5 ± 0.68	5.70 ± 0.85	5.47 ± 0.75	7.76 ± 2.19	8.03 ± 1.12	9.93 ± 0.94	9.83 ± 2.16	9.33 ± 2.03
	T2	6.13 ± 0.50	6.49 ± 0.49	6 ± 0.43	5.99 ± 0.18	6.16 ± 0.82	8.11 ± 1.81	8.65 ± 1.50	9.99 ± 1.14	10.41 ± 2.52	7.26 ± 1.28
	T3	6.61 ± 0.31	7.10 ± 0.91	6 ± 0.70	6.38 ± 0.42	6.23 ± 0.51	8.21 ± 1.69	8.86 ± 1.45	8.78 ± 0.92	6.57 ± 0.95	7.01 ± 1.22
	T4	6.76 ± 0.55	7.07 ± 1.02	7 ± 0.55	6.62 ± 0.43	6.47 ± 0.68	6.88 ± 1.57	7.13 ± 0.57	7.55 ± 1.08	7.08 ± 0.54	6.49 ± 0.88
	T5	6.98 ± 0.43	7.08 ± 0.71	6 ± 0.57	7.14 ± 0.57	6.68 ± 0.71	7.45 ± 1.77	7.27 ± 0.63	7.13 ± 0.46	7.19 ± 0.42	6.39 ± 0.37
	T6	7.66 ± 0.95	7.50 ± 0.67	7 ± 1.01	6.98 ± 0.60	7.73 ± 0.96	7.19 ± 0.70	7.64 ± 0.66	7.07 ± 0.72	7.32 ± 0.40	6.47 ± 0.43
	T7	8.08 ± 1.60	6.98 ± 1.14	7 ± 0.62	7.14 ± 0.18	7.51 ± 0.74	6.84 ± 0.95	7.21 ± 1.52	7.51 ± 0.60	7.16 ± 1.05	7.23 ± 0.59
xMx1 (mm)	T0	32.37 ± 0.49	31.51 ± 1.46	31 ± 0.54	30.91 ± 1.41	31.31 ± 1.06	32.41 ± 1.13	32.08 ± 0.71	32.85 ± 0.92	33.20 ± 0.88	33.33 ± 0.51
	T1	33.28 ± 0.76	32.69 ± 1.29	32 ± 0.67	32.40 ± 1.50	33.17 ± 1.27	32.46 ± 1.04	32.72 ± 1.17	33.19 ± 0.67	34.09 ± 1.10	33.82 ± 0.42
	T2	34.56 ± 0.50	33.52 ± 0.79	34 ± 0.62	33.59 ± 0.67	34.00 ± 0.65	33.36 ± 0.52	33.33 ± 0.64	34.27 ± 1.04	34.16 ± 0.87	34.09 ± 0.83
	T3	35.44 ± 0.30	34.57 ± 0.67	34 ± 0.52	34.51 ± 0.78	34.58 ± 0.69	33.92 ± 0.85	34.16 ± 0.64	34.40 ± 0.49	34.49 ± 0.48	34.13 ± 0.88
	T4	35.77 ± 0.34	35.51 ± 1.37	34 ± 0.71	35.16 ± 0.88	35.15 ± 0.59	34.33 ± 0.80	34.63 ± 0.80	35.10 ± 0.91	35.08 ± 0.56	34.99 ± 1.28
	T5	36.43 ± 0.46	35.67 ± 1.32	35 ± 1.15	36.14 ± 0.94	36.08 ± 0.83	35.22 ± 1.04	35.45 ± 0.74	35.18 ± 0.71	36.04 ± 0.28	35.40 ± 0.89
	T6	37.19 ± 1.99	36.51 ± 0.88	36 ± 1.03	36.63 ± 0.94	37.43 ± 0.80	36.59 ± 1.15	36.04 ± 1.49	36.14 ± 0.59	36.71 ± 0.54	36.17 ± 0.78
	T7	38.49 ± 0.47	37.14 ± 0.93	37 ± 0.29	37.57 ± 1.06	37.79 ± 0.49	37.47 ± 1.03	36.14 ± 2.61	37.05 ± 0.72	37.56 ± 0.79	37.07 ± 0.85
xMx2 (mm)	T0	32.31 ± 0.52	31.39 ± 1.82	31 ± 0.82	30.75 ± 1.70	30.99 ± 1.62	32.42 ± 1.35	32.33 ± 0.73	33.09 ± 1.05	33.58 ± 1.03	33.52 ± 0.72
	T1	33.57 ± 0.76	32.85 ± 1.69	32 ± 0.82	32.67 ± 1.73	33.24 ± 1.73	33.05 ± 1.35	32.71 ± 0.98	33.49 ± 0.76	34.23 ± 1.44	34.01 ± 0.70

	T2	35.17 ± 0.65	33.93 ± 1.24	34 ± 0.75	34.36 ± 0.90	34.55 ± 0.89	33.92 ± 0.74	34.10 ± 0.90	34.83 ± 1.09	34.66 ± 1.29	34.65 ± 0.72
	T3	36.19 ± 0.39	35.18 ± 0.82	34 ± 0.56	35.27 ± 0.90	35.65 ± 0.87	34.43 ± 1.25	34.74 ± 0.51	34.85 ± 0.97	35.11 ± 0.74	34.91 ± 0.66
	T4	36.76 ± 0.44	36.30 ± 1.73	35 ± 0.97	36.08 ± 0.79	36.36 ± 0.72	35.11 ± 0.98	35.73 ± 0.87	35.96 ± 1.44	36.11 ± 0.63	35.76 ± 1.26
	T5	37.83 ± 0.61	36.61 ± 1.53	36 ± 1.38	36.29 ± 1.94	37.39 ± 1.00	36.22 ± 1.41	36.59 ± 0.53	36.15 ± 0.83	37.38 ± 0.40	36.65 ± 0.92
	T6	38.46 ± 2.14	37.66 ± 1.10	37 ± 1.25	37.95 ± 1.01	38.85 ± 0.95	37.95 ± 1.33	36.79 ± 2.01	37.40 ± 0.67	38.42 ± 0.76	37.86 ± 0.77
	T7	39.55 ± 0.86	38.81 ± 1.14	37 ± 0.41	39.23 ± 1.01	39.55 ± 0.40	38.87 ± 0.82	37.16 ± 3.31	38.90 ± 0.70	39.26 ± 0.67	38.94 ± 0.99
Go1↔Go2 (mm)	T0	16.36 ± 0.53	16.23 ± 0.82	16 ± 0.19	16.30 ± 0.53	16.13 ± 0.68	15.97 ± 0.55	16.05 ± 0.32	16.14 ± 0.44	15.77 ± 0.92	16.35 ± 0.86
	T1	16.88 ± 0.32	16.69 ± 0.63	16 ± 0.47	16.94 ± 0.26	16.77 ± 0.48	16.27 ± 0.56	16.05 ± 0.32	16.14 ± 0.44	15.77 ± 0.92	16.35 ± 0.86
	T2	17.24 ± 0.36	16.51 ± 0.67	16 ± 0.21	17.33 ± 0.37	17.22 ± 0.25	16.04 ± 0.54	16.59 ± 0.21	16.91 ± 0.44	16.75 ± 0.66	16.93 ± 0.36
	T3	17.43 ± 0.37	16.51 ± 0.62	16 ± 0.35	17.36 ± 0.24	17.33 ± 0.27	16.03 ± 0.88	15.66 ± 0.59	15.58 ± 0.46	16.55 ± 0.42	16.89 ± 0.85
	T4	17.61 ± 0.51	17.17 ± 0.85	16 ± 0.30	17.82 ± 0.23	17.59 ± 0.18	16.11 ± 0.52	16.43 ± 0.24	16.51 ± 0.40	16.97 ± 0.41	17.13 ± 0.94
	T5	17.82 ± 0.40	17.21 ± 0.90	16 ± 0.42	18.04 ± 0.24	18.13 ± 0.48	16.77 ± 0.63	16.49 ± 0.33	16.32 ± 0.34	17.38 ± 0.62	17.57 ± 0.93
	T6	17.79 ± 0.46	17.56 ± 0.66	17 ± 0.20	17.95 ± 0.38	18.25 ± 0.44	17.37 ± 0.75	17.72 ± 0.66	17.06 ± 0.48	17.79 ± 0.83	17.72 ± 0.48
	T7	18.06 ± 0.51	18.13 ± 0.46	17 ± 0.19	18.22 ± 0.41	18.59 ± 0.59	18.03 ± 0.21	18.21 ± 0.40	18.00 ± 0.26	18.15 ± 0.37	18.19 ± 0.40
C1↔C2 (mm)	T0	14.83 ± 0.29	14.59 ± 0.64	14 ± 0.19	14.62 ± 0.32	14.43 ± 0.42	14.51 ± 0.43	14.72 ± 0.27	14.51 ± 0.30	15.01 ± 0.37	14.90 ± 0.47
	T1	15.11 ± 0.39	14.79 ± 0.51	14 ± 0.25	15.05 ± 0.28	14.99 ± 0.47	14.60 ± 0.62	14.90 ± 0.52	14.93 ± 0.26	15.21 ± 0.39	14.96 ± 0.32
	T2	15.36 ± 0.34	15.03 ± 0.47	14 ± 0.36	15.14 ± 0.56	15.31 ± 0.61	14.67 ± 0.44	15.08 ± 0.52	15.13 ± 0.31	15.29 ± 0.58	15.03 ± 0.34
	T3	15.58 ± 0.50	15.13 ± 0.50	15 ± 0.42	15.38 ± 0.19	15.41 ± 0.34	14.84 ± 0.57	15.19 ± 0.25	15.22 ± 1.02	15.37 ± 0.42	15.29 ± 0.38
	T4	15.81 ± 0.48	15.37 ± 0.72	15 ± 0.42	15.63 ± 0.35	15.67 ± 0.41	15.16 ± 0.34	15.24 ± 0.44	15.49 ± 0.46	15.49 ± 0.35	15.38 ± 0.37
	T5	16.05 ± 0.21	15.63 ± 0.61	15 ± 0.36	15.94 ± 0.29	15.95 ± 0.49	15.49 ± 0.57	15.63 ± 0.34	15.57 ± 0.59	15.81 ± 0.50	15.74 ± 0.44
	T6	16.28 ± 0.50	15.83 ± 0.53	15 ± 0.36	16.00 ± 0.48	16.04 ± 0.37	15.75 ± 0.47	16.26 ± 0.68	15.66 ± 0.20	16.10 ± 0.78	15.96 ± 0.55
	T7	16.63 ± 0.49	16.58 ± 0.54	16 ± 0.43	16.42 ± 0.59	16.71 ± 0.44	15.95 ± 0.41	16.47 ± 0.62	16.49 ± 0.08	16.30 ± 0.30	16.40 ± 0.41
Zp1↔Zp2 (mm)	T0	18.01 ± 0.52	17.63 ± 1.25	17 ± 0.32	17.59 ± 0.71	17.53 ± 0.87	18.08 ± 0.78	18.39 ± 0.38	18.45 ± 0.60	18.78 ± 0.48	18.69 ± 0.28
	T1	18.75 ± 0.56	18.37 ± 0.95	18 ± 0.22	18.62 ± 0.68	18.70 ± 0.88	18.64 ± 0.74	18.60 ± 0.39	18.66 ± 0.56	18.85 ± 0.55	18.88 ± 0.41
	T2	19.58 ± 0.72	18.84 ± 0.80	18 ± 0.32	19.54 ± 0.54	19.51 ± 0.70	18.75 ± 0.49	19.05 ± 0.33	19.02 ± 0.67	19.30 ± 0.60	19.14 ± 0.50
	T3	20.09 ± 0.61	19.15 ± 0.72	18 ± 0.56	19.78 ± 0.51	19.88 ± 0.51	19.08 ± 0.55	19.05 ± 0.30	19.25 ± 0.41	19.41 ± 0.70	19.64 ± 0.66
	T4	20.54 ± 0.59	19.76 ± 0.82	19 ± 0.43	20.57 ± 0.48	20.50 ± 0.57	19.29 ± 0.82	19.30 ± 0.29	19.49 ± 0.68	20.18 ± 0.50	20.19 ± 0.81
	T5	21.41 ± 0.47	19.85 ± 0.76	19 ± 0.43	21.05 ± 0.67	21.13 ± 0.80	20.30 ± 0.72	19.87 ± 0.36	20.21 ± 0.58	21.20 ± 0.50	20.92 ± 0.74

	T6	22.16 ± 0.60	20.65 ± 1.05	20 ± 0.28	21.62 ± 0.85	22.12 ± 0.72	21.45 ± 0.74	22.02 ± 0.61	20.79 ± 0.55	22.27 ± 0.97	21.70 ± 0.74
	T7	22.63 ± 0.46	21.71 ± 0.86	21 ± 0.35	22.30 ± 0.75	22.67 ± 0.70	22.34 ± 0.48	22.52 ± 0.54	21.79 ± 0.45	22.90 ± 0.84	22.49 ± 0.46
Cd1↔Cd2 (mm)	T0	15.38 ± 0.53	15.16 ± 0.85	15 ± 0.20	15.32 ± 0.41	15.26 ± 0.54	15.03 ± 1.27	15.58 ± 0.21	15.75 ± 0.44	15.90 ± 0.18	15.31 ± 0.94
	T1	15.98 ± 0.41	15.82 ± 0.58	15 ± 0.34	15.77 ± 0.39	15.89 ± 0.55	14.98 ± 0.58	15.02 ± 0.39	14.87 ± 0.45	14.74 ± 0.73	14.84 ± 0.92
	T2	16.59 ± 0.47	16.06 ± 0.63	16 ± 0.18	16.25 ± 0.34	16.52 ± 0.58	15.42 ± 0.62	15.23 ± 0.66	15.37 ± 0.54	15.08 ± 0.82	15.73 ± 0.56
	T3	17.03 ± 0.24	16.20 ± 0.50	15 ± 0.33	16.37 ± 0.34	16.77 ± 0.53	15.93 ± 0.64	15.34 ± 0.64	15.43 ± 0.54	16.34 ± 0.41	16.16 ± 0.60
	T4	17.28 ± 0.47	16.56 ± 0.90	15 ± 0.44	17.26 ± 0.48	17.22 ± 0.52	16.02 ± 0.68	16.13 ± 0.25	16.44 ± 0.50	16.89 ± 0.24	16.69 ± 0.64
	T5	18.20 ± 0.22	16.65 ± 0.69	16 ± 0.46	17.70 ± 0.67	17.75 ± 0.57	16.61 ± 0.57	16.33 ± 0.41	16.52 ± 0.61	17.56 ± 0.46	17.26 ± 0.63
	T6	18.74 ± 0.30	17.15 ± 0.74	16 ± 0.37	18.16 ± 0.85	18.55 ± 0.56	17.45 ± 0.57	18.14 ± 0.95	17.51 ± 0.62	18.29 ± 0.94	17.82 ± 0.62
	T7	19.33 ± 0.20	17.76 ± 1.01	17 ± 0.27	19.01 ± 0.61	19.07 ± 0.58	18.27 ± 0.49	18.42 ± 0.74	17.99 ± 0.35	18.78 ± 0.99	18.41 ± 0.75
P1↔P2 (mm)	T0	7.60 ± 0.21	7.39 ± 0.44	7 ± 0.17	7.28 ± 0.20	7.32 ± 0.44	7.31 ± 0.61	7.51 ± 0.13	7.58 ± 0.20	7.59 ± 0.17	7.44 ± 0.26
	T1	7.60 ± 0.24	7.46 ± 0.16	7 ± 0.22	7.45 ± 0.38	7.43 ± 0.31	7.43 ± 0.30	7.62 ± 0.43	7.64 ± 0.30	7.63 ± 0.24	7.53 ± 0.24
	T2	7.77 ± 0.21	7.53 ± 0.20	7 ± 0.10	7.74 ± 0.37	7.67 ± 0.35	7.55 ± 0.29	7.66 ± 0.64	7.67 ± 0.29	7.63 ± 0.36	7.68 ± 0.44
	T3	7.79 ± 0.27	7.66 ± 0.24	7 ± 0.22	7.85 ± 0.31	7.70 ± 0.28	7.62 ± 0.34	7.78 ± 0.67	7.85 ± 0.22	7.70 ± 0.27	7.76 ± 0.50
	T4	7.96 ± 0.26	7.92 ± 0.28	7 ± 0.13	7.88 ± 0.20	7.85 ± 0.16	7.69 ± 0.52	7.80 ± 0.32	7.86 ± 0.49	7.76 ± 0.14	7.84 ± 0.65
	T5	8.18 ± 0.21	8.14 ± 0.52	7 ± 0.57	8.07 ± 0.31	8.07 ± 0.22	7.76 ± 0.40	8.03 ± 0.53	8.02 ± 0.39	8.12 ± 0.19	7.94 ± 0.51
	T6	8.58 ± 0.34	8.23 ± 0.43	8 ± 0.58	8.42 ± 0.57	8.60 ± 0.52	8.18 ± 0.53	8.55 ± 0.42	8.08 ± 0.32	8.65 ± 0.60	7.98 ± 0.41
	T7	8.83 ± 0.42	8.61 ± 0.46	8 ± 0.89	8.63 ± 0.27	8.87 ± 0.32	8.42 ± 0.21	8.67 ± 0.25	8.50 ± 0.20	8.70 ± 0.14	8.28 ± 0.26
Za1↔Za2 (mm)	T0	8.60 ± 0.28	8.54 ± 0.55	8 ± 0.24	8.67 ± 0.38	8.67 ± 0.27	8.64 ± 0.27	8.88 ± 0.20	8.64 ± 0.19	8.84 ± 0.13	9.04 ± 0.21
	T1	8.85 ± 0.31	8.80 ± 0.33	8 ± 0.17	8.94 ± 0.27	9.13 ± 0.34	8.88 ± 0.32	9.27 ± 0.63	8.71 ± 0.19	8.88 ± 0.36	9.13 ± 0.54
	T2	9.28 ± 0.33	9.10 ± 0.40	9 ± 0.21	9.46 ± 0.34	9.28 ± 0.32	9.04 ± 0.20	9.24 ± 0.30	9.15 ± 0.38	9.34 ± 0.42	9.20 ± 0.31
	T3	9.47 ± 0.34	9.27 ± 0.35	9 ± 0.20	9.51 ± 0.30	9.47 ± 0.24	9.34 ± 0.24	9.38 ± 0.31	9.31 ± 0.28	9.37 ± 0.17	9.49 ± 0.32
	T4	9.55 ± 0.42	9.59 ± 0.44	9 ± 0.19	9.89 ± 0.23	9.71 ± 0.28	9.49 ± 0.40	9.73 ± 0.30	9.75 ± 0.22	9.76 ± 0.09	9.78 ± 0.35
	T5	10.11 ± 0.19	9.81 ± 0.42	9 ± 0.23	10.10 ± 0.32	10.01 ± 0.35	9.88 ± 0.40	10.03 ± 0.20	9.81 ± 0.30	10.22 ± 0.10	10.31 ± 0.31
	T6	10.41 ± 0.29	10.17 ± 0.28	9 ± 0.17	10.40 ± 0.56	10.52 ± 0.32	10.47 ± 0.34	10.73 ± 0.07	10.31 ± 0.36	10.51 ± 0.35	10.73 ± 0.18
	T7	10.69 ± 0.43	10.52 ± 0.31	10 ± 0.25	10.94 ± 0.42	10.84 ± 0.15	10.74 ± 0.35	11.03 ± 0.19	10.61 ± 0.27	10.69 ± 0.35	10.93 ± 0.22
Mx1↔Mx2 (mm)	T0	6.73 ± 0.19	6.69 ± 0.44	6 ± 0.10	6.67 ± 0.28	6.55 ± 0.40	6.79 ± 0.34	7.15 ± 0.05	6.95 ± 0.19	7.01 ± 0.17	7.10 ± 0.29
	T1	7.06 ± 0.16	6.97 ± 0.33	6 ± 0.21	7.17 ± 0.28	7.02 ± 0.30	7.33 ± 0.51	7.39 ± 0.35	7.27 ± 0.42	7.30 ± 0.18	7.33 ± 0.23

T2	7.41 ± 0.28	7.17 ± 0.47	7 ± 0.15	7.48 ± 0.16	7.50 ± 0.27	7.42 ± 0.31	7.61 ± 0.24	7.41 ± 0.35	7.43 ± 0.56	7.48 ± 0.23
T3	7.63 ± 0.17	7.41 ± 0.35	7 ± 0.15	7.57 ± 0.24	7.51 ± 0.24	7.52 ± 0.32	7.80 ± 0.29	7.66 ± 0.39	7.53 ± 0.24	7.59 ± 0.21
T4	7.76 ± 0.25	7.70 ± 0.41	7 ± 0.21	7.86 ± 0.17	7.86 ± 0.23	7.53 ± 0.32	7.90 ± 0.20	7.93 ± 0.45	7.83 ± 0.19	7.73 ± 0.30
T5	8.15 ± 0.12	7.79 ± 0.35	7 ± 0.21	8.04 ± 0.47	8.07 ± 0.25	7.86 ± 0.38	7.91 ± 0.19	7.98 ± 0.25	8.20 ± 0.15	8.04 ± 0.30
T6	8.38 ± 0.19	8.05 ± 0.33	8 ± 0.33	8.31 ± 0.31	8.24 ± 0.36	8.18 ± 0.32	8.35 ± 0.24	8.39 ± 0.23	8.47 ± 0.17	8.29 ± 0.27
T7	8.49 ± 0.23	8.55 ± 0.34	8 ± 0.39	8.61 ± 0.26	8.55 ± 0.40	8.32 ± 0.44	8.42 ± 0.20	8.61 ± 0.14	8.84 ± 0.31	8.56 ± 0.22

5.3.2.1 DVC-LT Anteroposterior Projection of Gonial Processes (xGo)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for xGo1 and xGo2 are displayed below (Table XLI). A line graph of the group means and a boxplot of xGo1 and xGo2 are displayed below in Figures 68 to 71. At T1 the MBL group had significantly more anterior gonial processes (xGo1, xGo2) than the CL, BL, SL, and SLR groups ($p \leq 0.001$). The MBLR group had significantly more anterior gonial processes (xGo1, xGo2) than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MSL group had significantly more anterior gonial processes than the CL group ($p \leq 0.01$). At T2 the MBLR groups had significantly more anterior gonial processes than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MSLR group had significantly more anterior gonial processes than the CL, SL, and SLR groups ($p \leq 0.01$). At T3 the MBLR groups had significantly more anterior gonial processes than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). The MSL and MSLR group had significantly more anterior gonial processes (xGo1, xGo2) than the CL group ($p \leq 0.01$). At T4 the MBL group had significantly more anterior gonial processes (xGo1, xGo2) than the SL, and SLR groups ($p \leq 0.01$). At T5 the MBL and MBLR groups had significantly more anterior gonial processes (xGo1, xGo2) than the CL group ($p \leq 0.01$). At T6 and T7 there were no significant differences between the groups for xGo1 and xGo2 at $p \leq 0.01$.

Table XLI: Multiple Comparisons Within Groups DVC-LT xGo1 and xGo2

* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$

Group	Variable	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval Lower	99% Confidence Interval Upper
CL	xGo1	0	1	-0.03	0.35	1.00	-1.68	1.61
			2	-0.08	0.25	1.00	-1.33	1.17
			3	0.10	0.27	1.00	-1.19	1.4
			4	0.10	0.41	1.00	-1.91	2.11
			5	0.98	0.27	0.09	-0.32	2.28
			6	0.78	0.33	0.61	-0.76	2.33
			7	0.56	0.44	1.00	-1.66	2.79
		1	2	-0.05	0.30	1.00	-1.63	1.54
			3	0.14	0.32	1.00	-1.45	1.72
			4	0.13	0.44	1.00	-1.95	2.22
			5	1.01	0.32	0.21	-0.57	2.6
			6	0.81	0.37	0.72	-0.91	2.54
			7	0.60	0.47	1.00	-1.67	2.86
		2	3	0.18	0.22	1.00	-0.84	1.21
			4	0.18	0.37	1.00	-1.86	2.22
			5	1.06*	0.22	0.01	0.03	2.08
			6	0.86	0.28	0.28	-0.59	2.31
			7	0.64	0.41	0.99	-1.64	2.93
		3	4	0.00	0.38	1.00	-2.02	2.01
			5	0.88	0.24	0.07	-0.24	1.99
			6	0.68	0.30	0.71	-0.79	2.14
			7	0.46	0.42	1.00	-1.79	2.70
		4	5	0.88	0.38	0.72	-1.13	2.89
			6	0.68	0.43	0.98	-1.37	2.73
			7	0.46	0.51	1.00	-1.95	2.88
		5	6	-0.20	0.30	1.00	-1.66	1.27
			7	-0.42	0.42	1.00	-2.66	1.83
		6	7	-0.22	0.46	1.00	-2.46	2.02
	xGo2	0	1	0.54	0.44	1.00	-1.52	2.60
			2	0.52	0.40	1.00	-1.43	2.47
			3	0.51	0.47	1.00	-1.68	2.69

Group	Variable	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval Lower	99% Confidence Interval Upper
ML	xGo1	0	1	-2.47	0.75	0.27	-6.93	1.98
			2	-2.75	0.76	0.17	-7.22	1.72
			3	-2.29	0.58	0.10	-5.58	0.99
			4	-1.40	0.64	0.81	-5.05	2.25
			5	-1.53	0.61	0.63	-4.99	1.94
			6	-0.30	0.53	1.00	-3.25	2.64
			7	0.59	0.39	0.99	-1.38	2.55
		1	2	-0.28	1.03	1.00	-5.1	4.54
			3	0.18	0.91	1.00	-4.18	4.54
			4	1.07	0.95	1.00	-3.4	5.54
			5	0.95	0.93	1.00	-3.46	5.36
			6	2.17	0.88	0.57	-2.12	6.45
			7	3.06	0.8	0.09	-1.20	7.32
		2	3	0.46	0.91	1.00	-3.92	4.83
			4	1.35	0.95	1.00	-3.13	5.83
			5	1.22	0.93	1.00	-3.20	5.64
			6	2.45	0.88	0.38	-1.85	6.74
			7	3.34	0.8	0.06	-0.94	7.61
		3	4	0.90	0.82	1.00	-2.94	4.73
			5	0.77	0.8	1.00	-2.96	4.50
			6	1.99	0.74	0.40	-1.49	5.47
			7	2.88	0.65	0.02	-0.33	6.09
		4	5	-0.13	0.84	1.00	-4.04	3.79
			6	1.10	0.78	1.00	-2.61	4.80
			7	1.99	0.69	0.35	-1.54	5.51
		5	6	1.22	0.76	0.98	-2.36	4.81
			7	2.11	0.67	0.22	-1.25	5.47
		6	7	0.89	0.6	0.99	-2.03	3.82
	xGo2	0	1	-3.79	1.25	0.27	-10.12	2.54
			2	-4.39	1.29	0.16	-11.00	2.21
			3	-3.05	0.89	0.11	-7.22	1.12

			4	0.44	0.49	1.00	-1.86	2.74
			5	1.36	0.43	0.19	-0.68	3.4
			6	1.19	0.56	0.78	-1.48	3.86
			7	0.85	0.60	1.00	-2.09	3.79
			2	-0.02	0.37	1.00	-1.77	1.73
			3	-0.03	0.44	1.00	-2.1	2.03
		1	4	-0.10	0.46	1.00	-2.3	2.1
			5	0.82	0.40	0.82	-1.05	2.69
			6	0.65	0.53	1.00	-1.97	3.27
			7	0.31	0.58	1.00	-2.61	3.23
			3	-0.01	0.40	1.00	-1.96	1.94
			4	-0.08	0.43	1.00	-2.2	2.04
		2	5	0.84	0.36	0.64	-0.86	2.54
			6	0.67	0.50	1.00	-1.94	3.28
			7	0.33	0.55	1.00	-2.61	3.27
			4	-0.07	0.49	1.00	-2.37	2.24
		3	5	0.85	0.43	0.86	-1.18	2.89
			6	0.68	0.56	1.00	-1.99	3.35
			7	0.34	0.60	1.00	-2.6	3.28
			5	0.92	0.46	0.85	-1.26	3.1
		4	6	0.75	0.58	1.00	-1.98	3.48
			7	0.41	0.62	1.00	-2.57	3.39
		5	6	-0.17	0.53	1.00	-2.78	2.44
			7	-0.51	0.57	1.00	-3.43	2.41
		6	7	-0.34	0.67	1.00	-3.49	2.81
BL			1	0.34	0.31	1.00	-1.11	1.78
			2	-0.14	0.27	1.00	-1.51	1.22
			3	-0.59	0.44	1.00	-2.78	1.61
		0	4	0.09	0.42	1.00	-1.98	2.15
			5	0.18	0.35	1.00	-1.47	1.82
	xGo1		6	0.78	0.33	0.61	-0.76	2.31
			7	1.17	0.32	0.07	-0.33	2.67
			2	-0.48	0.25	0.89	-1.67	0.71
		1	3	-0.92	0.43	0.79	-3.11	1.27
			4	-0.25	0.41	1.00	-2.3	1.8
			5	-0.16	0.33	1.00	-1.73	1.42

			4	-2.09	0.93	0.71	-6.49	2.31
			5	-2.50	0.92	0.38	-6.83	1.83
			6	-1.38	0.82	0.97	-5.21	2.45
			7	0.63	0.89	1.00	-3.52	4.77
			2	-0.60	1.57	1.00	-7.96	6.75
			3	0.74	1.27	1.00	-5.61	7.08
		1	4	1.70	1.30	1.00	-4.68	8.08
			5	1.29	1.29	1.00	-5.08	7.65
			6	2.41	1.22	0.89	-3.93	8.75
			7	4.42	1.27	0.13	-1.93	10.76
			3	1.34	1.31	1.00	-5.26	7.95
			4	2.30	1.34	0.96	-4.32	8.93
		2	5	1.89	1.33	1.00	-4.73	8.51
			6	3.01	1.26	0.66	-3.61	9.64
			7	5.02	1.31	0.07	-1.59	11.62
			4	0.96	0.97	1.00	-3.57	5.49
		3	5	0.55	0.95	1.00	-3.92	5.02
			6	1.67	0.86	0.88	-2.36	5.7
			7	3.68	0.92	0.04	-0.62	7.98
			5	-0.41	1.00	1.00	-5.06	4.24
		4	6	0.71	0.90	1.00	-3.58	5
			7	2.71	0.96	0.32	-1.8	7.22
		5	6	1.12	0.89	1.00	-3.09	5.33
			7	3.13	0.95	0.14	-1.32	7.57
		6	7	2.00	0.85	0.62	-2	6.01
			1	-4.27*	0.61	0.00	-7.8	-0.75
			2	-4.77*	0.74	0.01	-9.19	-0.36
			3	-4.45	0.76	0.01	-8.98	0.08
		0	4	-1.90*	0.29	0.00	-3.26	-0.56
			5	-1.64	0.37	0.03	-3.5	0.23
MBL	xGo1		6	-1.15	0.35	0.18	-2.9	0.6
			7	-0.82	0.28	0.28	-2.13	0.5
			2	-0.50	0.93	1.00	-4.89	3.89
		1	3	-0.18	0.94	1.00	-4.64	4.29
			4	2.37	0.62	0.12	-1.11	5.84
			5	2.64	0.67	0.06	-0.76	6.04

			6	0.44	0.31	1.00	-1	1.88
			7	0.84	0.30	0.32	-0.56	2.23
		2	3	-0.44	0.40	1.00	-2.68	1.8
			4	0.23	0.38	1.00	-1.85	2.31
			5	0.32	0.30	1.00	-1.2	1.84
			6	0.92	0.27	0.15	-0.43	2.27
			7	1.31*	0.26	0.01	0.03	2.6
		3	4	0.67	0.52	1.00	-1.74	3.09
			5	0.76	0.46	0.97	-1.46	2.99
			6	1.36	0.44	0.24	-0.84	3.56
			7	1.76	0.44	0.05	-0.44	3.95
		4	5	0.09	0.44	1.00	-2.01	2.19
			6	0.69	0.42	0.98	-1.37	2.75
			7	1.08	0.41	0.48	-0.97	3.14
		5	6	0.6	0.35	0.96	-1.04	2.24
			7	0.99	0.34	0.28	-0.62	2.61
		6	7	0.4	0.32	1.00	-1.09	1.88
	xGo2	0	1	0.65	0.39	0.97	-1.18	2.48
			2	-0.02	0.34	1.00	-1.6	1.56
			3	-0.31	0.53	1.00	-3.04	2.43
			4	0.15	0.48	1.00	-2.23	2.52
			5	1.03	0.49	0.82	-1.43	3.49
			6	0.68	0.34	0.85	-0.91	2.27
			7	1.62	0.63	0.57	-1.79	5.04
		1	2	-0.67	0.37	0.93	-2.43	1.09
			3	-0.96	0.55	0.96	-3.7	1.78
			4	-0.51	0.50	1.00	-2.92	1.91
			5	0.37	0.51	1.00	-2.12	2.86
			6	0.02	0.37	1.00	-1.74	1.79
			7	0.97	0.65	0.99	-2.42	4.35
		2	3	-0.29	0.52	1.00	-3.04	2.46
			4	0.16	0.46	1.00	-2.2	2.53
			5	1.04	0.48	0.77	-1.41	3.5
			6	0.70	0.31	0.70	-0.76	2.15
			7	1.64	0.62	0.54	-1.82	5.09
		3	4	0.45	0.62	1.00	-2.47	3.38

			6	3.12	0.66	0.02	-0.28	6.52
			7	3.46*	0.62	0.01	-0.03	6.94
		2	3	0.33	1.03	1.00	-4.49	5.14
			4	2.87	0.75	0.13	-1.49	7.23
			5	3.14	0.79	0.08	-1.09	7.37
			6	3.62	0.78	0.03	-0.62	7.87
			7	3.96	0.75	0.02	-0.42	8.34
		3	4	2.54	0.77	0.25	-1.93	7.01
			5	2.82	0.80	0.16	-1.52	7.15
			6	3.30	0.80	0.06	-1.05	7.65
			7	3.63	0.77	0.04	-0.85	8.12
		4	5	0.27	0.39	1.00	-1.61	2.16
			6	0.76	0.37	0.84	-1.03	2.54
			7	1.09	0.30	0.08	-0.33	2.51
		5	6	0.48	0.44	1.00	-1.57	2.54
			7	0.82	0.38	0.79	-1.06	2.69
		6	7	0.34	0.37	1.00	-1.44	2.11
	xGo2	0	1	-5.35*	0.87	0.01	-10.8	0.09
			2	-5.91	1.08	0.02	-12.72	0.89
			3	-5.32	1.08	0.04	-12.14	1.49
			4	-1.87*	0.26	0.00	-3.2	-0.55
			5	-2.35	0.45	0.02	-4.95	0.25
			6	-0.70	0.64	1.00	-4.56	3.16
			7	-0.48	0.67	1.00	-4.59	3.63
		1	2	-0.56	1.38	1.00	-7.08	5.96
			3	0.03	1.38	1.00	-6.5	6.56
			4	3.48	0.89	0.12	-1.81	8.77
			5	3.01	0.96	0.26	-2.03	8.04
			6	4.66	1.06	0.02	-0.47	9.78
			7	4.88	1.09	0.02	-0.31	10.06
		2	3	0.59	1.52	1.00	-6.5	7.68
			4	4.04	1.10	0.17	-2.63	10.7
			5	3.57	1.16	0.30	-2.78	9.91
			6	5.22	1.24	0.04	-1.03	11.46
			7	5.44	1.26	0.03	-0.82	11.69
		3	4	3.45	1.10	0.34	-3.22	10.12

			5	1.33	0.63	0.78	-1.63	4.29
			6	0.98	0.52	0.92	-1.76	3.73
			7	1.93	0.75	0.47	-1.61	5.47
		4	5	0.88	0.59	0.99	-1.86	3.62
			6	0.53	0.46	1.00	-1.84	2.90
			7	1.47	0.71	0.82	-1.96	4.91
		5	6	-0.35	0.48	1.00	-2.80	2.10
			7	0.59	0.72	1.00	-2.86	4.05
		6	7	0.94	0.62	0.99	-2.51	4.39
BLR	xGo1	0	1	-0.44	0.32	1.00	-1.92	1.04
			2	-0.96	0.33	0.26	-2.49	0.57
			3	-0.63	0.31	0.82	-2.08	0.81
			4	-0.76	0.34	0.71	-2.38	0.85
			5	0.09	0.47	1.00	-2.31	2.49
			6	0.67	0.41	0.98	-1.33	2.66
			7	0.51	0.32	0.98	-1.00	2.02
		1	2	-0.52	0.33	0.98	-2.06	1.01
			3	-0.20	0.31	1.00	-1.65	1.26
			4	-0.32	0.35	1.00	-1.95	1.30
			5	0.53	0.47	1.00	-1.87	2.93
			6	1.10	0.41	0.41	-0.89	3.10
			7	0.95	0.32	0.26	-0.57	2.47
		2	3	0.33	0.32	1.00	-1.18	1.84
			4	0.20	0.35	1.00	-1.46	1.86
			5	1.05	0.48	0.76	-1.35	3.45
			6	1.63	0.42	0.05	-0.38	3.64
			7	1.48	0.33	0.02	-0.09	3.04
		3	4	-0.13	0.34	1.00	-1.73	1.47
			5	0.72	0.47	0.99	-1.68	3.13
			6	1.30	0.4	0.19	-0.69	3.29
			7	1.15	0.32	0.08	-0.34	2.63
		4	5	0.85	0.49	0.96	-1.56	3.26
			6	1.43	0.43	0.14	-0.62	3.47
			7	1.28	0.35	0.07	-0.37	2.92
		5	6	0.58	0.53	1.00	-1.95	3.10
			7	0.42	0.47	1.00	-1.98	2.82

			5	2.98	1.16	0.57	-3.37	9.32
			6	4.63	1.24	0.09	-1.62	10.87
			7	4.85	1.26	0.07	-1.41	11.11
		4	5	-0.47	0.49	1.00	-2.97	2.02
			6	1.18	0.66	0.96	-2.53	4.88
			7	1.40	0.70	0.90	-2.55	5.34
		5	6	1.65	0.76	0.75	-2.02	5.32
			7	1.87	0.79	0.63	-1.99	5.73
		6	7	0.22	0.91	1.00	-4.02	4.46
MBLR	xGo1	0	1	-5.01*	0.47	0.00	-7.46	-2.57
			2	-4.96*	0.50	0.00	-7.64	-2.29
			3	-4.19*	0.44	0.00	-6.48	-1.91
			4	-2.06	0.60	0.19	-5.39	1.28
			5	-1.57	0.42	0.09	-3.69	0.55
			6	-0.04	0.32	1.00	-1.54	1.46
			7	0.61	0.29	0.77	-0.73	1.95
		1	2	0.05	0.62	1.00	-2.85	2.95
			3	0.82	0.57	1.00	-1.87	3.51
			4	2.96	0.70	0.03	-0.39	6.31
			5	3.44*	0.56	0.00	0.83	6.06
			6	4.97*	0.49	0.00	2.53	7.42
			7	5.62*	0.47	0.00	3.18	8.08
		2	3	0.77	0.60	1.00	-2.06	3.6
			4	2.91	0.72	0.04	-0.51	6.33
			5	3.39*	0.58	0.00	0.62	6.16
			6	4.92*	0.52	0.00	2.27	7.58
			7	5.57*	0.50.	0.00	2.90	8.26
		3	4	2.14	0.68	0.21	-1.17	5.45
			5	2.62*	0.54	0.01	0.11	5.13
			6	4.15*	0.46	0.00	1.87	6.45
			7	4.80*	0.44	0.00	2.52	7.10
		4	5	0.49	0.67	1.00	-2.80	3.77
			6	2.02	0.61	0.21	-1.27	5.31
			7	2.67	0.59	0.04	-0.67	6.01
		5	6	1.53	0.44	0.11	-0.61	3.68
			7	2.18*	0.42	0.01	0.06	4.31

		6	7	-0.15	0.41	1.00	-2.16	1.85
	xGo2	0	1	-0.22	0.44	1.00	-2.27	1.84
			2	-1.45	0.40	0.08	-3.31	0.42
			3	-0.76	0.60	1.00	-3.84	2.32
			4	-1.03	0.36	0.31	-2.75	0.68
			5	0.47	0.42	1.00	-1.50	2.44
			6	0.99	0.56	0.95	-1.81	3.79
			7	0.66	0.30	0.81	-1.01	2.34
		1	2	-1.23	0.44	0.33	-3.28	0.83
			3	-0.54	0.63	1.00	-3.63	2.55
			4	-0.82	0.40	0.85	-2.77	1.14
			5	0.69	0.46	0.99	-1.45	2.82
			6	1.21	0.58	0.83	-1.63	4.04
			7	0.88	0.35	0.62	-1.12	2.88
		2	3	0.69	0.60	1.00	-2.39	3.77
			4	0.41	0.36	1.00	-1.30	2.12
			5	1.91*	0.42	0.01	-0.06	3.88
			6	2.43	0.56	0.03	-0.36	5.23
			7	2.11*	0.30	0.00	0.44	3.78
		3	4	-0.28	0.58	1.00	-3.39	2.84
			5	1.22	0.61	0.87	-1.86	4.30
			6	1.74	0.72	0.56	-1.61	5.10
			7	1.42	0.54	0.60	-1.88	4.71
		4	5	1.50	0.38	0.05	-0.35	3.35
			6	2.02	0.53	0.09	-0.79	4.83
			7	1.69*	0.25	0.00	0.38	3.01
		5	6	0.52	0.57	1.00	-2.29	3.34
			7	0.20	0.33	1.00	-1.67	2.06
		6	7	-0.33	0.49	1.00	-3.30	2.65
SL	xGo1	0	1	-0.15	0.34	1.00	-1.73	1.42
			2	0.12	0.29	1.00	-1.23	1.46
			3	0.02	0.30	1.00	-1.37	1.41
			4	0.02	0.25	1.00	-1.26	1.30
			5	0.18	0.27	1.00	-1.12	1.48
			6	0.79	0.25	0.22	-0.49	2.07
			7	1.12	0.32	0.10	-0.40	2.64

		6	7	0.65	0.32	0.82	-0.84	2.14
	xGo2	0	1	-7.41*	0.61	0.00	-10.99	-3.84
			2	-7.52*	0.76	0.00	-12.10	-2.94
			3	-5.64*	0.43	0.00	-8.01	-3.28
			4	-2.38	0.66	0.19	-6.33	1.58
			5	-2.29	0.52	0.05	-5.28	0.69
			6	0.04	0.42	1.00	-2.23	2.31
			7	0.61	0.37	0.98	-1.34	2.55
		1	2	-0.10	0.94	1.00	-4.58	4.37
			3	1.77	0.71	0.54	-1.67	5.22
			4	5.04*	0.87	0.00	0.96	9.12
			5	5.12*	0.77	0.00	1.51	8.74
			6	7.45*	0.70	0.00	4.02	10.89
			7	8.02*	0.67	0.00	4.62	11.43
		2	3	1.88	0.84	0.75	-2.42	6.17
			4	5.14*	0.98	0.00	0.54	9.75
			5	5.22*	0.89	0.00	0.89	9.57
			6	7.56*	0.83	0.00	3.26	11.86
			7	8.12*	0.81	0.00	3.80	12.46
		3	4	3.27	0.76	0.03	-0.49	7.03
			5	3.35*	0.64	0.00	0.34	6.37
			6	5.68*	0.56	0.00	3.08	8.28
			7	6.25*	0.52	0.00	3.79	8.71
		4	5	0.08	0.81	1.00	-3.79	3.95
			6	2.41	0.75	0.20	-1.34	6.16
			7	2.98	0.72	0.05	-0.77	6.73
		5	6	2.33	0.63	0.07	-0.66	5.32
			7	2.9*	0.60	0.01	-0.01	5.81
		6	7	0.57	0.51	1.00	-1.83	2.96
MSL	xGo1	0	1	-5.75*	0.95	0.01	-11.53	0.03
			2	-2.54	0.56	0.04	-5.67	0.58
			3	-1.68	0.58	0.39	-4.91	1.55
			4	-0.44	0.38	1.00	-2.34	1.46
			5	0.09	0.28	1.00	-1.21	1.39
			6	0.43	0.32	1.00	-1.06	1.92
			7	0.58	0.26	0.73	-0.66	1.82

		1	2	0.27	0.31	1.00	-1.24	1.77
			3	0.17	0.32	1.00	-1.36	1.70
			4	0.17	0.28	1.00	-1.31	1.65
			5	0.33	0.30	1.00	-1.14	1.81
			6	0.94	0.28	0.18	-0.54	2.43
			7	1.27	0.35	0.07	-0.35	2.90
		2	3	-0.10	0.27	1.00	-1.36	1.17
			4	-0.10	0.22	1.00	-1.17	0.97
			5	0.07	0.24	1.00	-1.06	1.19
			6	0.68	0.21	0.21	-0.39	1.74
			7	1.01	0.30	0.14	-0.43	2.44
		3	4	0.00	0.23	1.00	-1.16	1.16
			5	0.16	0.25	1.00	-1.04	1.36
			6	0.77	0.23	0.16	-0.39	1.93
			7	1.10	0.31	0.09	-0.36	2.57
		4	5	0.16	0.19	1.00	-0.76	1.09
			6	0.77*	0.16	0.01	0.02	1.53
			7	1.10	0.27	0.05	-0.28	2.49
		5	6	0.61	0.19	0.17	-0.30	1.52
			7	0.94	0.28	0.16	-0.45	2.33
		6	7	0.33	0.26	1.00	-1.06	1.72
	xGo2	0	1	0.24	0.35	1.00	-1.46	1.94
			2	0.74	0.35	0.8	-0.97	2.46
			3	0.40	0.26	0.99	-0.82	1.63
			4	0.33	0.31	1.00	-1.13	1.79
			5	0.28	0.32	1.00	-1.27	1.82
			6	0.92	0.37	0.54	-0.89	2.73
			7	1.59*	0.28	0.00	0.28	2.92
		1	2	0.50	0.41	1.00	-1.42	2.43
			3	0.16	0.34	1.00	-1.53	1.85
			4	0.08	0.38	1.00	-1.69	1.86
			5	0.03	0.39	1.00	-1.79	1.86
			6	0.68	0.42	0.98	-1.31	2.66
			7	1.36	0.36	0.06	-0.36	3.07
		2	3	-0.34	0.34	1.00	-2.04	1.37
			4	-0.42	0.38	1.00	-2.20	1.37

		1	2	3.20	1.07	0.29	-2.21	8.62
			3	4.07	1.08	0.08	-1.35	9.49
			4	5.31*	0.99	0.01	-0.26	10.88
			5	5.83*	0.95	0.01	0.05	11.63
			6	6.17*	0.96	0.01	0.47	11.89
			7	6.32*	0.95	0.01	0.50	12.16
		2	3	0.87	0.76	1.00	-2.67	4.40
			4	2.11	0.62	0.14	-0.96	5.17
			5	2.64	0.56	0.03	-0.49	5.77
			6	2.98*	0.58	0.01	-0.10	6.05
			7	3.13*	0.55	0.01	-0.04	6.29
		3	4	1.24	0.63	0.89	-1.92	4.40
			5	1.77	0.58	0.32	-1.47	5.01
			6	2.11	0.59	0.14	-1.07	5.29
			7	2.26	0.57	0.10	-1.01	5.53
		4	5	0.53	0.38	1.00	-1.37	2.43
			6	0.87	0.41	0.78	-1.08	2.82
			7	1.02	0.37	0.42	-0.88	2.92
		5	6	0.34	0.31	1.00	-1.14	1.82
			7	0.49	0.26	0.90	-0.72	1.70
		6	7	0.15	0.30	1.00	-1.29	1.59
	xGo2	0	1	-7.81*	1.26	0.01	-15.23	-0.39
			2	-3.50	0.72	0.02	-7.19	0.19
			3	-3.62*	0.64	0.00	-6.81	-0.43
			4	-1.18	0.56	0.80	-3.86	1.50
			5	-0.47	0.45	1.00	-2.60	1.66
			6	0.13	0.42	1.00	-1.86	2.13
			7	1.08	0.51	0.79	-1.33	3.48
		1	2	4.32	1.37	0.24	-2.76	11.39
			3	4.19	1.33	0.26	-2.94	11.32
			4	6.63	1.30	0.02	-0.61	13.87
			5	7.34*	1.25	0.01	-0.13	14.82
			6	7.95*	1.24	0.01	0.37	15.52
			7	8.89*	1.28	0.00	1.55	16.23
		2	3	-0.12	0.84	1.00	-4.06	3.82
			4	2.32	0.78	0.27	-1.44	6.07

			5	-0.47	0.39	1.00	-2.30	1.37
			6	0.18	0.43	1.00	-1.82	2.17
			7	0.86	0.36	0.61	-0.87	2.59
		3	4	-0.08	0.30	1.00	-1.51	1.35
			5	-0.13	0.31	1.00	-1.65	1.40
			6	0.52	0.36	1.00	-1.29	2.32
			7	1.20	0.27	0.02	-0.08	2.47
		4	5	-0.05	0.35	1.00	-1.71	1.60
			6	0.59	0.39	0.99	-1.28	2.46
			7	1.27	0.32	0.04	-0.22	2.76
		5	6	0.64	0.40	0.98	-1.26	2.55
			7	1.32	0.33	0.04	-0.25	2.89
		6	7	0.68	0.37	0.93	-1.14	2.50
SLR	xGo1	0	1	-0.06	0.30	1.00	-1.58	1.46
			2	-0.24	0.37	1.00	-1.97	1.50
			3	-0.24	0.31	1.00	-1.77	1.30
			4	-0.04	0.28	1.00	-1.59	1.51
			5	0.08	0.28	1.00	-1.47	1.63
			6	0.12	0.34	1.00	-1.47	1.72
			7	0.78	0.39	0.85	-1.04	2.59
		1	2	-0.18	0.31	1.00	-1.71	1.36
			3	-0.18	0.23	1.00	-1.27	0.92
			4	0.02	0.19	1.00	-0.89	0.93
			5	0.14	0.18	1.00	-0.77	1.05
			6	0.19	0.26	1.00	-1.08	1.45
			7	0.84	0.33	0.53	-0.83	2.50
		2	3	0.00	0.32	1.00	-1.55	1.55
			4	0.20	0.28	1.00	-1.37	1.76
			5	0.31	0.28	1.00	-1.25	1.88
			6	0.36	0.34	1.00	-1.24	1.97
			7	1.01	0.39	0.45	-0.81	2.84
		3	4	0.20	0.20	1.00	-0.82	1.21
			5	0.31	0.20	0.99	-0.70	1.33
			6	0.36	0.28	1.00	-0.94	1.66
			7	1.01	0.34	0.27	-0.66	2.68
		4	5	0.12	0.14	1.00	-0.54	0.78

			5	3.03	0.70	0.04	-0.68	6.73
			6	3.63*	0.68	0.01	-0.13	7.39
			7	4.57*	0.74	0.00	0.88	8.27
		3	4	2.44	0.71	0.11	-0.90	5.78
			5	3.15*	0.63	0.01	-0.03	6.33
			6	3.75*	0.60	0.00	0.55	6.96
			7	4.69*	0.67	0.00	1.46	7.93
		4	5	0.71	0.54	1.00	-1.93	3.35
			6	1.32	0.51	0.52	-1.29	3.92
			7	2.26	0.59	0.05	-0.52	5.04
		5	6	0.60	0.39	0.99	-1.25	2.46
			7	1.55	0.49	0.19	-0.79	3.88
		6	7	0.94	0.46	0.83	-1.31	3.20
MSLR	xGo1	0	1	-3.47	0.94	0.18	-9.34	2.40
			2	-2.35	0.47	0.03	-5.06	0.36
			3	-1.89	0.54	0.20	-5.04	1.26
			4	0.21	0.50	1.00	-2.70	3.12
			5	0.77	0.25	0.21	-0.42	1.96
			6	0.69	0.22	0.19	-0.34	1.72
			7	0.83	0.32	0.54	-0.85	2.52
		1	2	1.12	1.04	1.00	-4.32	6.56
			3	1.58	1.07	0.99	-3.84	7.00
			4	3.68	1.05	0.14	-1.75	9.10
			5	4.24	0.95	0.07	-1.55	10.02
			6	4.16	0.95	0.08	-1.69	10.00
			7	4.30	0.98	0.06	-1.33	9.94
		2	3	0.46	0.69	1.00	-2.76	3.69
			4	2.56	0.66	0.05	-0.53	5.64
			5	3.11*	0.49	0.00	0.48	5.76
			6	3.03*	0.48	0.00	0.35	5.72
			7	3.18*	0.54	0.00	0.55	5.82
		3	4	2.09	0.71	0.25	-1.21	5.40
			5	2.66	0.55	0.03	-0.41	5.73
			6	2.57	0.54	0.04	-0.55	5.70
			7	2.72	0.59	0.02	-0.29	5.73
		4	5	0.56	0.52	1.00	-2.27	3.40

			6	0.17	0.24	1.00	-1.08	1.41
			7	0.82	0.30	0.51	-0.89	2.53
		5	6	0.05	0.23	1.00	-1.20	1.29
			7	0.70	0.30	0.75	-1.01	2.41
		6	7	0.65	0.36	0.93	-1.06	2.36
	xGo2	0	1	-0.05	0.31	1.00	-1.94	1.84
			2	-0.29	0.44	1.00	-2.37	1.79
			3	0.04	0.35	1.00	-1.74	1.82
			4	-0.22	0.43	1.00	-2.21	1.76
			5	-0.30	0.47	1.00	-2.51	1.92
			6	0.11	0.46	1.00	-2.06	2.28
			7	0.42	0.51	1.00	-2.02	2.86
		1	2	-0.24	0.33	1.00	-2.23	1.76
			3	0.09	0.19	1.00	-0.97	1.15
			4	-0.17	0.30	1.00	-1.99	1.65
			5	-0.24	0.37	1.00	-2.48	1.99
			6	0.16	0.35	1.00	-1.99	2.32
			7	0.47	0.41	1.00	-2.09	3.03
		2	3	0.33	0.37	1.00	-1.54	2.20
			4	0.06	0.44	1.00	-1.98	2.11
			5	-0.01	0.48	1.00	-2.26	2.25
			6	0.40	0.47	1.00	-1.81	2.61
			7	0.71	0.52	1.00	-1.76	3.18
		3	4	-0.26	0.35	1.00	-1.99	1.46
			5	-0.34	0.40	1.00	-2.42	1.75
			6	0.07	0.39	1.00	-1.95	2.09
			7	0.38	0.45	1.00	-2.02	2.78
		4	5	-0.07	0.46	1.00	-2.27	2.12
			6	0.33	0.46	1.00	-1.81	2.48
			7	0.64	0.50	1.00	-1.78	3.07
		5	6	0.41	0.50	1.00	-1.92	2.73
			7	0.72	0.54	1.00	-1.84	3.27
		6	7	0.31	0.54	1.00	-2.21	2.83

			6	0.48	0.51	1.00	-2.40	3.37
			7	0.63	0.56	1.00	-2.18	3.43
		5	6	-0.08	0.26	1.00	-1.30	1.14
			7	0.06	0.35	1.00	-1.64	1.77
		6	7	0.15	0.33	1.00	-1.54	1.83
	xGo2	0	1	-5.27	1.36	0.15	-13.86	3.32
			2	-3.20*	0.52	0.01	-6.24	-0.17
			3	-2.86	0.53	0.02	-5.94	0.22
			4	-0.19	0.56	1.00	-3.50	3.11
			5	0.55	0.28	0.88	-0.83	1.93
			6	0.69	0.34	0.86	-1.09	2.47
			7	0.39	0.52	1.00	-2.65	3.42
		1	2	2.06	1.44	1.00	-5.98	10.10
			3	2.41	1.44	0.98	-5.62	10.44
			4	5.08	1.45	0.17	-2.91	13.06
			5	5.82	1.37	0.09	-2.65	14.29
			6	5.96	1.38	0.08	-2.40	14.32
			7	5.66	1.44	0.10	-2.38	13.69
		2	3	0.35	0.71	1.00	-2.97	3.67
			4	3.02	0.74	0.03	-0.43	6.46
			5	3.75*	0.55	0.00	0.84	6.67
			6	3.89*	0.59	0.00	0.99	6.81
			7	3.59*	0.71	0.01	0.30	6.90
		3	4	2.67	0.74	0.08	-0.80	6.13
			5	3.40*	0.56	0.00	0.45	6.36
			6	3.54*	0.59	0.00	0.60	6.49
			7	3.25*	0.71	0.01	-0.07	6.57
		4	5	0.74	0.59	1.00	-2.43	3.91
			6	0.88	0.62	1.00	-2.26	4.03
			7	0.58	0.74	1.00	-2.86	4.03
		5	6	0.14	0.39	1.00	-1.70	1.98
			7	-0.16	0.55	1.00	-3.08	2.76
		6	7	-0.30	0.59	1.00	-3.21	2.61

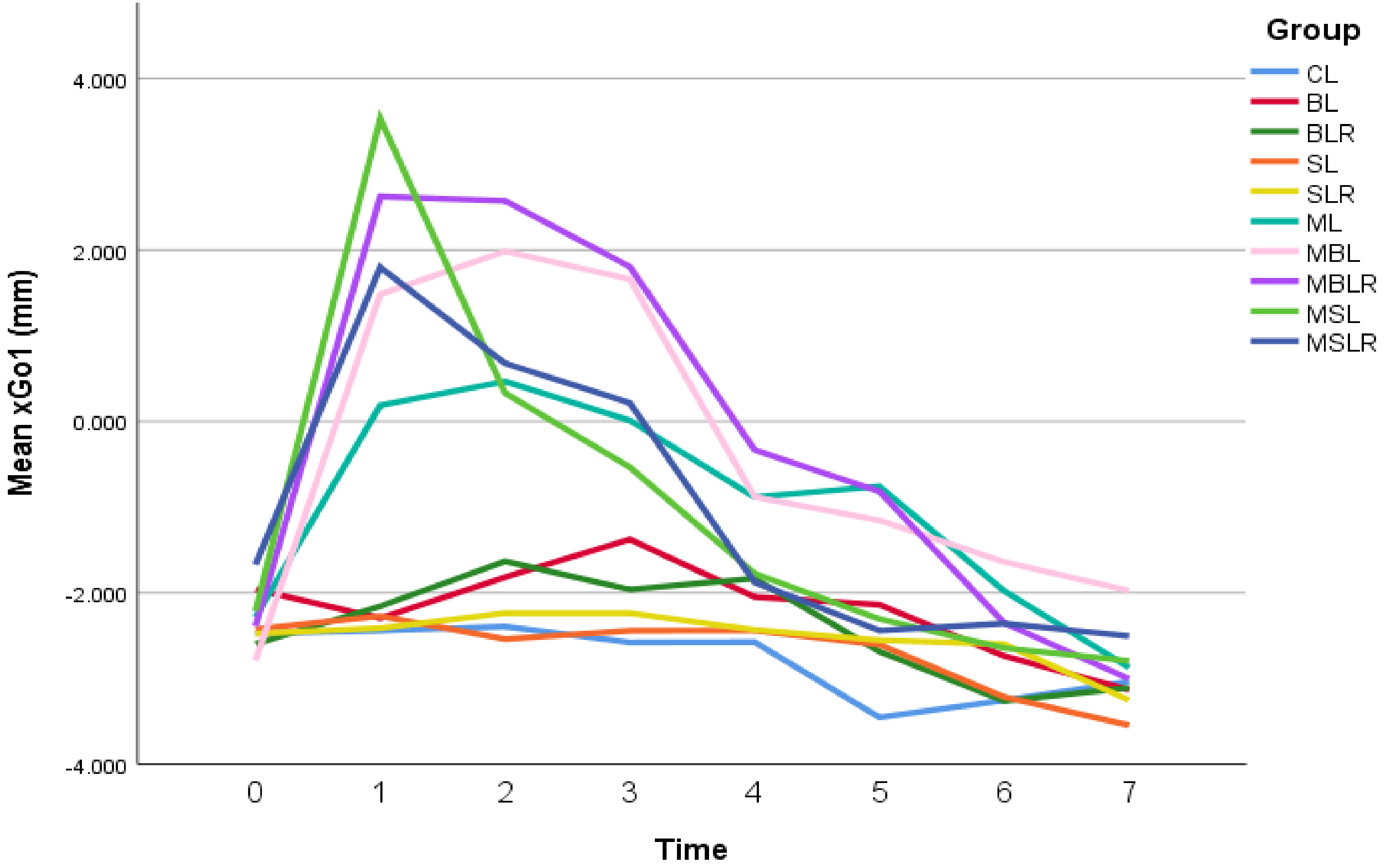


Figure 68: Line graph of xGo1 (mm) for DVC-LT groups at timepoints T0 to T7

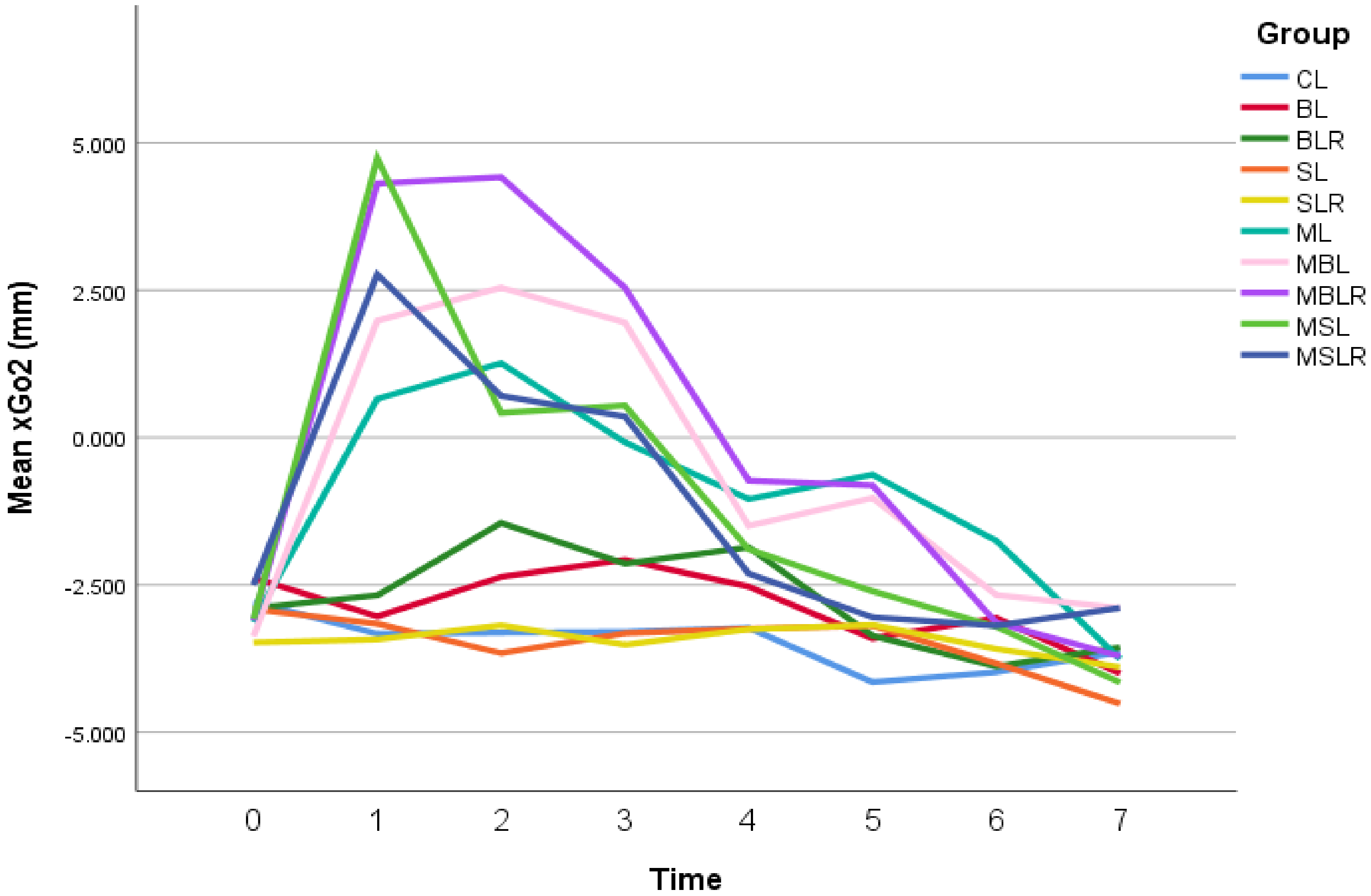


Figure 69: Line graph of xGo2 (mm) for DVC-LT groups at timepoints T0 to T7

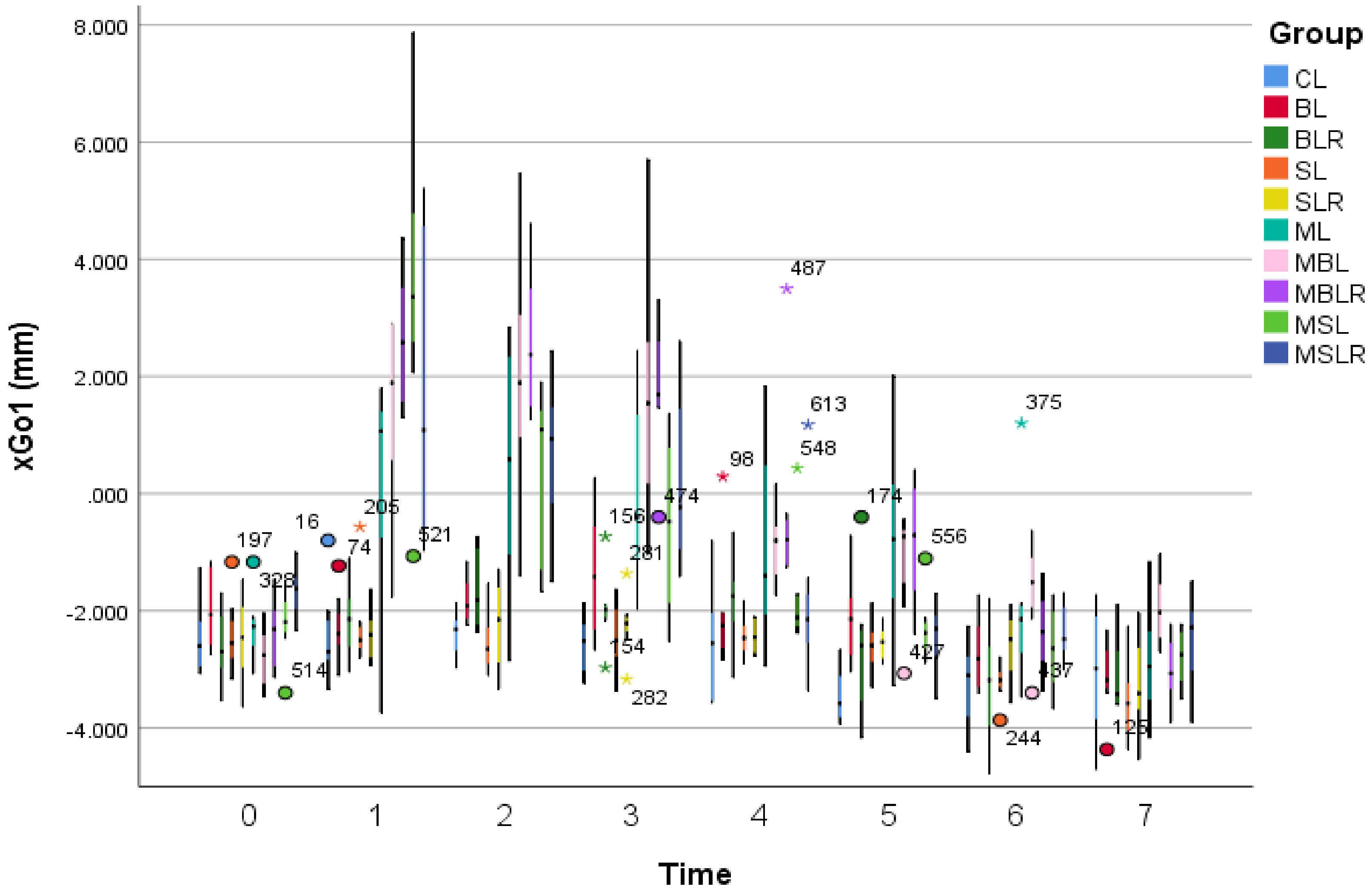


Figure 70: Boxplot of xGo1 (mm) for DVC-LT groups at timepoints T0 to T7

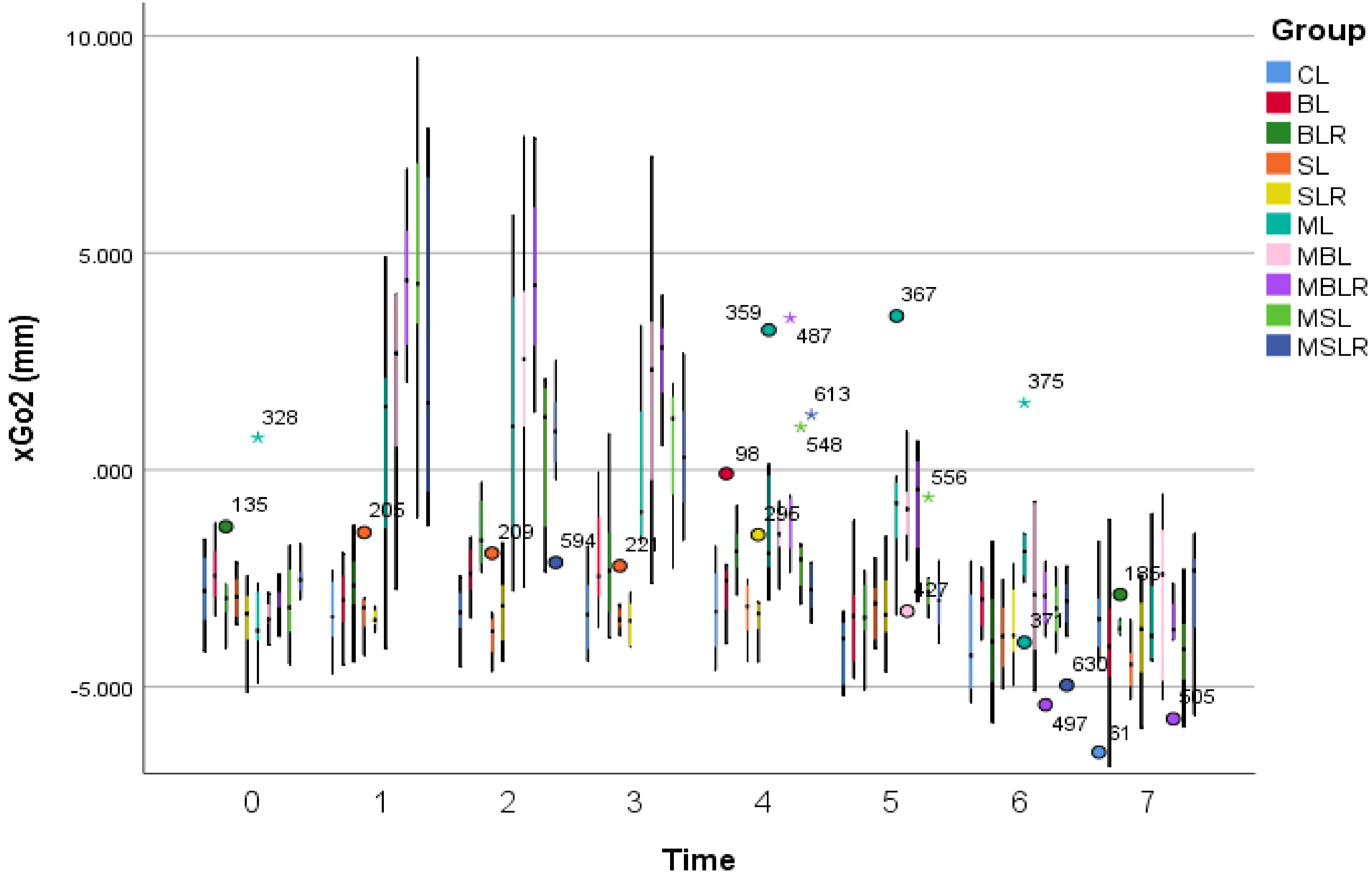


Figure 71: Boxplot of xGo2 (mm) for DVC-LT groups at timepoints T0 to T7

5.3.2.2 DVC-LT Anteroposterior Projection of Coronoid Processes (xCd)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for xCd1 and xCd2 are displayed below (Table XLII). A line graph of the group means and a boxplot of xCd1 and xCd2 are displayed below in Figures 72 to 75. At T0 MSLR has more anterior coronoid processes (xCd1, xCd2) than BLR, SLR, and MBL groups ($p \leq 0.01$). There were no significant differences within the MSLR group for the position of xCd1 and xCd2. At T1 the MBL groups had significantly more anterior coronoid processes (xCd1, xCd2) than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.01$). The MBLR groups had significantly more anterior coronoid processes (xCd1, xCd2) than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). T2 The MBLR group had significantly more anterior coronoid processes (xCd1, xCd2) than the CL, BL, BLR, SL, and SLR groups ($p \leq 0.001$). T3 The MBLR groups had significantly more anterior coronoid processes (xCd1, xCd2) than the CL, BL, BLR, SL, SLR and MSL groups ($p \leq 0.001$). There were no significant differences between the groups at T4, T5, T6, and T7 for xCd1 and xCd2.

Table XLII: Multiple Comparisons Within Groups DVC-LT for xCd1 and xCd2

Group	Variable	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Variable	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$							Lower	Upper								Lower	Upper
CL	xCd1	0	1	-0.32	0.30	1.00	-1.73	1.09	ML	xCd1	0	1	-2.72	0.86	0.32	-7.82	2.38
			2	-0.76	0.27	0.31	-2.02	0.49				2	-2.75	0.71	0.11	-6.80	1.31
			3	-1.00	0.26	0.05	-2.23	0.23				3	-3.08	0.68	0.04	-6.92	0.77
			4	-1.13	0.35	0.17	-2.81	0.55				4	-1.62	0.63	0.58	-5.17	1.92
			5	-1.04	0.25	0.03	-2.23	0.15				5	-2.14	0.68	0.29	-5.98	1.69
			6	-0.93	0.38	0.61	-2.84	0.98				6	-1.13	0.46	0.59	-3.47	1.21
			7	-0.99	0.42	0.66	-3.14	1.15				7	-0.73	0.39	0.92	-2.65	1.18
		1	2	-0.44	0.29	0.99	-1.80	0.92			1	2	-0.03	1.07	1.00	-5.10	5.04
			3	-0.68	0.28	0.58	-2.02	0.66				3	-0.36	1.05	1.00	-5.37	4.65
			4	-0.81	0.36	0.70	-2.53	0.91				4	1.09	1.02	1.00	-3.84	6.02
			5	-0.72	0.27	0.43	-2.04	0.59				5	0.57	1.05	1.00	-4.43	5.58
			6	-0.61	0.40	0.99	-2.54	1.32				6	1.58	0.92	0.97	-3.27	6.44
			7	-0.67	0.43	0.99	-2.82	1.48				7	1.98	0.89	0.78	-2.95	6.91
		2	3	-0.24	0.24	1.00	-1.38	0.91			2	3	-0.33	0.93	1.00	-4.68	4.02
			4	-0.37	0.34	1.00	-2.03	1.29				4	1.12	0.90	1.00	-3.09	5.34
			5	-0.28	0.23	1.00	-1.38	0.82				5	0.60	0.93	1.00	-3.74	4.95

			6	-0.17	0.37	1.00	-2.08	1.74				6	1.61	0.78	0.84	-2.31	5.54
			7	-0.23	0.41	1.00	-2.38	1.92				7	2.01	0.75	0.47	-1.92	5.94
		3	4	-0.13	0.33	1.00	-1.79	1.52			3	4	1.45	0.87	0.97	-2.64	5.55
			5	-0.04	0.22	1.00	-1.09	1.01				5	0.93	0.91	1.00	-3.30	5.17
			6	0.07	0.37	1.00	-1.84	1.98				6	1.94	0.76	0.51	-1.80	5.69
			7	0.01	0.40	1.00	-2.15	2.17				7	2.34	0.72	0.21	-1.39	6.08
		4	5	0.09	0.32	1.00	-1.56	1.75			4	5	-0.52	0.87	1.00	-4.61	3.57
			6	0.20	0.43	1.00	-1.84	2.24				6	0.49	0.72	1.00	-3.00	3.99
			7	0.14	0.47	1.00	-2.08	2.36				7	0.89	0.68	1.00	-2.57	4.35
		5	6	0.11	0.36	1.00	-1.81	2.03			5	6	1.01	0.76	1.00	-2.72	4.74
			7	0.05	0.40	1.00	-2.13	2.23				7	1.41	0.72	0.89	-2.31	5.13
		6	7	-0.06	0.49	1.00	-2.38	2.25			6	7	0.40	0.52	1.00	-2.05	2.85
	xCd2	0	1	-0.33	0.28	1.00	-1.63	0.97		xCd2	0	1	-2.62	0.81	0.27	-7.31	2.07
			2	-0.74	0.27	0.38	-2.02	0.54				2	-2.97	0.68	0.05	-6.78	0.85
			3	-1.21*	0.23	0.01	-2.41	-0.02				3	-3.07	0.64	0.03	-6.60	0.47
			4	-1.36*	0.28	0.01	-2.68	-0.04				4	-1.73	0.60	0.39	-5.01	1.54
			5	-1.58*	0.25	0.00	-2.81	-0.36				5	-2.31	0.67	0.18	-6.02	1.40
			6	-2.26*	0.39	0.00	-4.21	-0.31				6	-2.05*	0.34	0.00	-3.65	-0.46
			7	-2.68	0.60	0.05	-6.05	0.69				7	-1.70	0.41	0.03	-3.68	0.28
		1	2	-0.41	0.26	0.98	-1.61	0.80			1	2	-0.35	1.00	1.00	-5.09	4.40
			3	-0.88	0.22	0.05	-1.97	0.20				3	-0.44	0.98	1.00	-5.10	4.21
			4	-1.03	0.27	0.05	-2.29	0.23				4	0.89	0.95	1.00	-3.70	5.48
			5	-1.25*	0.24	0.00	-2.39	-0.12				5	0.31	0.99	1.00	-4.40	5.02
			6	-1.93*	0.38	0.01	-3.88	0.02				6	0.57	0.81	1.00	-4.10	5.24
			7	-2.35	0.60	0.10	-5.75	1.05				7	0.92	0.84	1.00	-3.63	5.47
		2	3	-0.47	0.21	0.71	-1.51	0.56			2	3	-0.10	0.88	1.00	-4.19	4.00
			4	-0.62	0.26	0.61	-1.85	0.61				4	1.24	0.85	0.99	-2.75	5.22
			5	-0.85	0.23	0.08	-1.95	0.25				5	0.66	0.89	1.00	-3.52	4.84
			6	-1.52	0.38	0.06	-3.47	0.42				6	0.92	0.69	1.00	-2.88	4.71
			7	-1.94	0.59	0.26	-5.35	1.47				7	1.27	0.72	0.96	-2.45	5.00
		3	4	-0.15	0.22	1.00	-1.27	0.98			3	4	1.33	0.82	0.98	-2.49	5.15
			5	-0.37	0.19	0.86	-1.27	0.52				5	0.76	0.86	1.00	-3.28	4.80
			6	-1.05	0.35	0.37	-3.06	0.97				6	1.01	0.65	0.99	-2.51	4.53
			7	-1.47	0.58	0.64	-5.00	2.06				7	1.37	0.68	0.87	-2.10	4.84
		4	5	-0.22	0.25	1.00	-1.39	0.94			4	5	-0.58	0.84	1.00	-4.50	3.35
			6	-0.90	0.39	0.68	-2.85	1.05				6	-0.32	0.61	1.00	-3.58	2.94

			7	-1.32	0.60	0.80	-4.71	2.07				7	0.04	0.65	1.00	-3.21	3.28
		5	6	-0.68	0.37	0.94	-2.64	1.29			5	6	0.26	0.67	1.00	-3.44	3.95
			7	-1.09	0.58	0.95	-4.55	2.36				7	0.61	0.71	1.00	-3.02	4.24
		6	7	-0.42	0.66	1.00	-3.71	2.87			6	7	0.36	0.42	1.00	-1.65	2.36
BL	xCd1	0	1	-0.19	0.32	1.00	-1.69	1.32	MBL	xCd1	0	1	-3.73*	0.48	0.00	-6.38	-1.09
			2	-0.79	0.30	0.45	-2.21	0.63				2	-4.65*	0.77	0.01	-9.29	-0.01
			3	-1.60	0.46	0.13	-3.91	0.72				3	-4.64*	0.70	0.01	-8.85	-0.45
			4	-1.58	0.46	0.14	-3.90	0.74				4	-1.37	0.31	0.02	-2.87	0.13
			5	-2.04*	0.29	0.00	-3.42	-0.68				5	-1.44	0.31	0.02	-2.96	0.07
			6	-1.58*	0.29	0.00	-2.97	-0.20				6	-1.44	0.34	0.04	-3.16	0.28
			7	-1.33	0.30	0.02	-2.76	0.09				7	-1.10	0.36	0.25	-2.93	0.72
		1	2	-0.60	0.30	0.85	-2.01	0.81			1	2	-0.92	0.87	1.00	-5.28	3.45
			3	-1.41	0.46	0.25	-3.72	0.90				3	-0.92	0.81	1.00	-4.91	3.08
			4	-1.40	0.46	0.27	-3.71	0.92				4	2.36	0.51	0.02	-0.23	4.95
			5	-1.86*	0.28	0.00	-3.22	-0.51				5	2.29	0.51	0.03	-0.30	4.88
			6	-1.39*	0.29	0.01	-2.77	-0.03				6	2.29	0.53	0.03	-0.32	4.91
			7	-1.15	0.30	0.05	-2.56	0.26				7	2.63*	0.54	0.01	0.00	5.26
		2	3	-0.81	0.44	0.94	-3.13	1.51			2	3	0.00	1.01	1.00	-4.75	4.75
			4	-0.80	0.44	0.95	-3.12	1.53				4	3.28	0.79	0.08	-1.21	7.77
			5	-1.26*	0.26	0.01	-2.50	-0.03				5	3.21	0.79	0.09	-1.28	7.70
			6	-0.80	0.27	0.25	-2.05	0.46				6	3.21	0.81	0.08	-1.23	7.65
			7	-0.55	0.28	0.87	-1.86	0.76				7	3.55	0.81	0.05	-0.87	7.96
		3	4	0.01	0.56	1.00	-2.62	2.64			3	4	3.28	0.73	0.04	-0.77	7.33
			5	-0.45	0.43	1.00	-2.79	1.88				5	3.21	0.73	0.05	-0.84	7.26
			6	0.01	0.44	1.00	-2.32	2.34				6	3.21	0.74	0.05	-0.80	7.22
			7	0.26	0.44	1.00	-2.06	2.58				7	3.55	0.75	0.02	-0.45	7.54
		4	5	-0.47	0.43	1.00	-2.81	1.87			4	5	-0.07	0.36	1.00	-1.78	1.63
			6	0.00	0.44	1.00	-2.34	2.33				6	-0.07	0.39	1.00	-1.91	1.77
			7	0.25	0.45	1.00	-2.07	2.57				7	0.27	0.41	1.00	-1.65	2.18
		5	6	0.47	0.25	0.91	-0.70	1.64			5	6	0.01	0.39	1.00	-1.84	1.85
			7	0.72	0.26	0.38	-0.52	1.95				7	0.34	0.41	1.00	-1.58	2.26
		6	7	0.25	0.27	1.00	-1.01	1.51			6	7	0.33	0.43	1.00	-1.68	2.35
	xCd2	0	1	-0.39	0.39	1.00	-2.23	1.45		xCd2	0	1	-2.75*	0.40	0.01	-5.25	-0.26
			2	-1.40	0.32	0.03	-2.98	0.18				2	-3.37	0.54	0.01	-6.74	0.00
			3	-2.00*	0.42	0.01	-3.99	-0.02				3	-3.58*	0.52	0.01	-6.83	-0.34
			4	-1.98	0.45	0.02	-4.13	0.17				4	-1.84*	0.21	0.00	-3.05	-0.65

			5	-1.98*	0.37	0.00	-3.71	-0.26				5	-1.98*	0.23	0.00	-3.34	-0.64
			6	-2.40*	0.36	0.00	-4.10	-0.72				6	-2.36*	0.24	0.00	-3.78	-0.94
			7	-1.89	0.48	0.06	-4.25	0.48				7	-1.93	0.54	0.22	-5.34	1.48
		1	2	-1.01	0.33	0.27	-2.67	0.66			1	2	-0.62	0.66	1.00	-3.79	2.56
			3	-1.62	0.43	0.06	-3.64	0.41				3	-0.83	0.65	1.00	-3.92	2.25
			4	-1.59	0.46	0.11	-3.76	0.59				4	0.90	0.44	0.86	-1.41	3.21
			5	-1.60	0.38	0.03	-3.38	0.19				5	0.76	0.45	0.97	-1.54	3.07
			6	-2.01*	0.37	0.00	-3.77	-0.27				6	0.39	0.46	1.00	-1.92	2.70
			7	-1.50	0.49	0.24	-3.88	0.88				7	0.82	0.67	1.00	-2.38	4.02
		2	3	-0.61	0.37	0.98	-2.49	1.27			2	3	-0.22	0.74	1.00	-3.67	3.24
			4	-0.58	0.40	1.00	-2.68	1.52				4	1.52	0.57	0.52	-1.64	4.68
			5	-0.59	0.31	0.90	-2.07	0.90				5	1.38	0.58	0.67	-1.75	4.51
			6	-1.01	0.29	0.12	-2.42	0.40				6	1.01	0.58	0.97	-2.11	4.13
			7	-0.49	0.44	1.00	-2.85	1.88				7	1.44	0.76	0.90	-2.09	4.97
		3	4	0.03	0.48	1.00	-2.23	2.30			3	4	1.74	0.55	0.28	-1.30	4.77
			5	0.02	0.41	1.00	-1.93	1.97				5	1.60	0.56	0.40	-1.41	4.61
			6	-0.40	0.40	1.00	-2.32	1.52				6	1.22	0.56	0.80	-1.78	4.22
			7	0.12	0.52	1.00	-2.32	2.57				7	1.66	0.74	0.70	-1.81	5.13
		4	5	-0.01	0.44	1.00	-2.13	2.11			4	5	-0.14	0.30	1.00	-1.54	1.26
			6	-0.43	0.43	1.00	-2.54	1.68				6	-0.51	0.31	0.97	-1.96	0.94
			7	0.09	0.54	1.00	-2.44	2.62				7	-0.08	0.57	1.00	-3.27	3.11
		5	6	-0.42	0.35	1.00	-2.04	1.20			5	6	-0.37	0.32	1.00	-1.88	1.14
			7	0.10	0.47	1.00	-2.25	2.45				7	0.06	0.58	1.00	-3.10	3.23
		6	7	0.52	0.47	1.00	-1.82	2.86			6	7	0.43	0.59	1.00	-2.72	3.59
BLR	xCd1	0	1	-0.75	0.33	0.70	-2.38	0.87	MBLR	xCd1	0	1	-5.02*	0.46	0.00	-7.57	-2.48
			2	-1.28	0.37	0.14	-3.18	0.61				2	-4.54*	0.44	0.00	-7.00	-2.09
			3	-1.28	0.45	0.40	-3.68	1.13				3	-5.25*	0.46	0.00	-7.80	-2.71
			4	-1.84	0.52	0.18	-4.78	1.11				4	-2.33	0.69	0.24	-6.45	1.80
			5	-1.40	0.56	0.63	-4.60	1.80				5	-1.00	0.28	0.10	-2.37	0.36
			6	-1.96*	0.27	0.00	-3.22	-0.71				6	-0.75	0.33	0.71	-2.42	0.92
			7	-2.03*	0.36	0.00	-3.84	-0.23				7	-1.17	0.30	0.05	-2.63	0.28
		1	2	-0.53	0.43	1.00	-2.55	1.49			1	2	0.48	0.60	1.00	-2.30	3.27
			3	-0.52	0.50	1.00	-2.93	1.89				3	-0.23	0.61	1.00	-3.06	2.59
			4	-1.08	0.57	0.91	-3.95	1.79				4	2.70	0.79	0.14	-1.21	6.61
			5	-0.65	0.60	1.00	-3.74	2.45				5	4.01*	0.49	0.00	1.53	6.51
			6	-1.21	0.34	0.10	-2.86	0.44				6	4.27*	0.52	0.00	1.76	6.79

			7	-1.28	0.42	0.21	-3.24	0.68				7	3.84*	0.50	0.00	1.36	6.34
		2	3	0.01	0.52	1.00	-2.48	2.49			2	3	-0.71	0.60	1.00	-3.50	2.07
			4	-0.55	0.59	1.00	-3.44	2.34				4	2.22	0.79	0.36	-1.68	6.12
			5	-0.12	0.62	1.00	-3.22	2.98				5	3.53*	0.47	0.00	1.13	5.95
			6	-0.68	0.38	0.95	-2.58	1.22				6	3.79*	0.50	0.00	1.35	6.23
			7	-0.75	0.45	0.97	-2.86	1.35				7	3.36*	0.48	0.00	0.96	5.78
		3	4	-0.56	0.64	1.00	-3.59	2.47			3	4	2.93	0.79	0.08	-0.98	6.84
			5	-0.13	0.67	1.00	-3.33	3.07				5	4.25*	0.49	0.00	1.77	6.74
			6	-0.69	0.46	0.99	-3.08	1.70				6	4.50*	0.51	0.00	1.99	7.02
			7	-0.76	0.51	0.99	-3.21	1.69				7	4.08*	0.49	0.00	1.59	6.57
		4	5	0.43	0.73	1.00	-2.96	3.83			4	5	1.32	0.71	0.94	-2.68	5.33
			6	-0.13	0.53	1.00	-3.04	2.78				6	1.57	0.73	0.81	-2.36	5.51
			7	-0.20	0.58	1.00	-3.08	2.68				7	1.15	0.71	0.99	-2.82	5.13
		5	6	-0.56	0.57	1.00	-3.72	2.60			5	6	0.25	0.37	1.00	-1.49	2.00
			7	-0.63	0.62	1.00	-3.73	2.46				7	-0.17	0.34	1.00	-1.76	1.42
		6	7	-0.07	0.37	1.00	-1.89	1.75			6	7	-0.42	0.38	1.00	-2.21	1.36
	xCd2	0	1	-0.53	0.31	0.95	-1.99	0.92		xCd2	0	1	-4.49*	0.36	0.00	-6.43	-2.55
			2	-1.57*	0.24	0.00	-2.73	-0.43				2	-4.55*	0.43	0.00	-6.96	-2.15
			3	-1.56*	0.31	0.01	-3.05	-0.08				3	-3.34*	0.36	0.00	-5.26	-1.44
			4	-1.94*	0.27	0.00	-3.22	-0.67				4	-2.12	0.41	0.02	-4.37	0.14
			5	-1.50*	0.28	0.00	-2.80	-0.21				5	-1.69*	0.22	0.00	-2.73	-0.66
			6	-1.72	0.41	0.04	-3.81	0.36				6	-1.63*	0.30	0.01	-3.12	-0.15
			7	-1.93*	0.29	0.00	-3.30	-0.57				7	-2.08*	0.26	0.00	-3.33	-0.84
		1	2	-1.04	0.28	0.09	-2.45	0.36			1	2	-0.06	0.52	1.00	-2.53	2.41
			3	-1.03	0.34	0.24	-2.64	0.58				3	1.15	0.46	0.54	-1.02	3.32
			4	-1.41	0.31	0.01	-2.88	0.06				4	2.37*	0.50	0.01	0.01	4.75
			5	-0.97	0.31	0.20	-2.45	0.51				5	2.79*	0.37	0.00	0.87	4.73
			6	-1.19	0.43	0.38	-3.29	0.91				6	2.85*	0.42	0.00	0.87	4.85
			7	-1.40	0.33	0.02	-2.92	0.13				7	2.41*	0.39	0.00	0.48	4.35
		2	3	0.01	0.29	1.00	-1.43	1.45			2	3	1.21	0.52	0.65	-1.25	3.66
			4	-0.37	0.25	0.99	-1.54	0.81				4	2.44	0.55	0.02	-0.16	5.04
			5	0.07	0.25	1.00	-1.12	1.27				5	2.85*	0.44	0.00	0.47	5.24
			6	-0.14	0.39	1.00	-2.26	1.97				6	2.91*	0.48	0.00	0.56	5.28
			7	-0.35	0.27	1.00	-1.65	0.94				7	2.47*	0.46	0.01	0.12	4.82
		3	4	-0.38	0.32	1.00	-1.88	1.12			3	4	1.23	0.50	0.55	-1.12	3.59
			5	0.06	0.32	1.00	-1.45	1.57				5	1.65	0.36	0.03	-0.25	3.55

			6	-0.16	0.44	1.00	-2.27	1.95				6	1.71	0.41	0.03	-0.26	3.68
			7	-0.37	0.33	1.00	-1.92	1.18				7	1.27	0.39	0.17	-0.64	3.17
		4	5	0.44	0.28	0.99	-0.87	1.75			4	5	0.42	0.41	1.00	-1.82	2.66
			6	0.22	0.41	1.00	-1.86	2.30				6	0.48	0.46	1.00	-1.76	2.71
			7	0.01	0.29	1.00	-1.37	1.39				7	0.03	0.44	1.00	-2.18	2.25
		5	6	-0.22	0.41	1.00	-2.30	1.86			5	6	0.06	0.30	1.00	-1.43	1.56
			7	-0.43	0.30	1.00	-1.82	0.97				7	-0.38	0.27	1.00	-1.65	0.89
		6	7	-0.21	0.42	1.00	-2.30	1.88			6	7	-0.44	0.33	1.00	-2.01	1.12
SL	xCd1	0	1	-0.84	0.42	0.86	-2.81	1.14	MSL	xCd1	0	1	-5.45	1.08	0.03	-11.80	0.90
			2	-1.09	0.34	0.19	-2.76	0.57				2	-5.82	1.36	0.08	-14.06	2.41
			3	-1.50	0.32	0.02	-3.14	0.15				3	-0.87	0.35	0.57	-2.58	0.85
			4	-1.72*	0.30	0.01	-3.44	-0.01				4	-1.25	0.32	0.08	-2.96	0.45
			5	-1.84*	0.30	0.01	-3.54	-0.16				5	-1.09	0.39	0.33	-2.91	0.73
			6	-1.55	0.30	0.02	-3.24	0.13				6	-1.21	0.38	0.17	-2.99	0.57
			7	-1.68*	0.33	0.01	-3.34	-0.04				7	-1.00	0.33	0.29	-2.69	0.69
		1	2	-0.26	0.37	1.00	-2.07	1.56			1	2	-0.37	1.69	1.00	-8.39	7.65
			3	-0.66	0.35	0.92	-2.48	1.16				3	4.59	1.06	0.08	-1.92	11.09
			4	-0.89	0.32	0.50	-2.79	1.01				4	4.20	1.05	0.13	-2.40	10.80
			5	-1.01	0.33	0.32	-2.89	0.86				5	4.36	1.07	0.10	-2.04	10.77
			6	-0.72	0.33	0.82	-2.59	1.15				6	4.25	1.07	0.12	-2.19	10.69
			7	-0.85	0.35	0.63	-2.67	0.96				7	4.46	1.05	0.09	-2.11	11.02
		2	3	-0.40	0.24	0.97	-1.56	0.75			2	3	4.96	1.34	0.18	-3.42	13.33
			4	-0.64	0.21	0.30	-1.75	0.48				4	4.57	1.33	0.26	-3.89	13.03
			5	-0.76	0.22	0.13	-1.86	0.35				5	4.73	1.35	0.22	-3.55	13.02
			6	-0.46	0.22	0.81	-1.57	0.64				6	4.62	1.35	0.25	-3.70	12.93
			7	-0.60	0.25	0.60	-1.78	0.58				7	4.83	1.34	0.21	-3.60	13.25
		3	4	-0.23	0.17	1.00	-1.11	0.65			3	4	-0.39	0.24	0.98	-1.56	0.78
			5	-0.35	0.18	0.89	-1.24	0.54				5	-0.22	0.33	1.00	-1.77	1.33
			6	-0.06	0.18	1.00	-0.95	0.84				6	-0.34	0.31	1.00	-1.81	1.13
			7	-0.19	0.22	1.00	-1.24	0.86				7	-0.13	0.26	1.00	-1.34	1.08
		4	5	-0.12	0.13	1.00	-0.75	0.51			4	5	0.16	0.29	1.00	-1.33	1.66
			6	0.17	0.14	1.00	-0.47	0.82				6	0.05	0.27	1.00	-1.35	1.45
			7	0.04	0.19	1.00	-0.92	1.00				7	0.26	0.21	1.00	-0.73	1.24
		5	6	0.30	0.15	0.83	-0.39	0.98			5	6	-0.12	0.35	1.00	-1.76	1.53
			7	0.16	0.19	1.00	-0.80	1.12				7	0.09	0.30	1.00	-1.41	1.60
		6	7	-0.14	0.20	1.00	-1.10	0.83			6	7	0.21	0.29	1.00	-1.20	1.62

	xCd2	0	1	-1.11	0.44	0.50	-3.16	0.95		xCd2	0	1	-4.34	0.83	0.01	-8.81	0.13
			2	-1.40	0.33	0.08	-3.40	0.60				2	-4.92	0.95	0.02	-10.22	0.37
			3	-1.78	0.35	0.02	-3.66	0.09				3	-1.08	0.48	0.68	-3.31	1.15
			4	-2.03*	0.35	0.01	-3.90	-0.16				4	-1.59	0.39	0.05	-3.56	0.38
			5	-2.54*	0.38	0.00	-4.41	-0.67				5	-1.70	0.37	0.03	-3.69	0.29
			6	-2.38*	0.38	0.00	-4.27	-0.51				6	-1.83	0.37	0.02	-3.83	0.17
			7	-2.54*	0.33	0.00	-4.55	-0.55				7	-1.68	0.50	0.13	-4.03	0.68
		1	2	-0.29	0.31	1.00	-2.16	1.58			1	2	-0.59	1.17	1.00	-6.10	4.93
			3	-0.67	0.33	0.88	-2.43	1.08				3	3.26	0.83	0.08	-1.21	7.73
			4	-0.92	0.34	0.44	-2.68	0.83				4	2.75	0.79	0.21	-1.93	7.43
			5	-1.44	0.36	0.05	-3.20	0.33				5	2.63	0.78	0.25	-2.12	7.39
			6	-1.28	0.37	0.11	-3.06	0.50				6	2.51	0.78	0.31	-2.26	7.27
			7	-1.44	0.31	0.05	-3.31	0.43				7	2.66	0.85	0.25	-1.78	7.11
		2	3	-0.38	0.16	0.67	-1.25	0.48			2	3	3.84	0.95	0.08	-1.46	9.14
			4	-0.63	0.17	0.10	-1.53	0.27				4	3.33	0.91	0.18	-2.20	8.87
			5	-1.15	0.21	0.02	-2.37	0.08				5	3.22	0.90	0.21	-2.38	8.82
			6	-0.99	0.22	0.05	-2.28	0.30				6	3.09	0.90	0.25	-2.52	8.70
			7	-1.14*	0.09	0.00	-1.57	-0.73				7	3.25	0.97	0.20	-2.01	8.50
		3	4	-0.25	0.21	1.00	-1.24	0.74			3	4	-0.51	0.39	1.00	-2.46	1.44
			5	-0.76	0.25	0.24	-1.97	0.44				5	-0.62	0.37	0.97	-2.59	1.35
			6	-0.61	0.26	0.64	-1.86	0.65				6	-0.75	0.36	0.86	-2.73	1.23
			7	-0.77	0.16	0.02	-1.63	0.10				7	-0.60	0.50	1.00	-2.94	1.75
		4	5	-0.51	0.25	0.85	-1.73	0.70			4	5	-0.11	0.24	1.00	-1.27	1.04
			6	-0.36	0.26	1.00	-1.62	0.90				6	-0.24	0.24	1.00	-1.38	0.90
			7	-0.52	0.17	0.28	-1.42	0.38				7	-0.09	0.42	1.00	-2.25	2.08
		5	6	0.15	0.29	1.00	-1.22	1.53			5	6	-0.13	0.21	1.00	-1.09	0.84
			7	0.00	0.21	1.00	-1.23	1.22				7	0.03	0.40	1.00	-2.17	2.23
		6	7	-0.16	0.22	1.00	-1.45	1.13			6	7	0.15	0.40	1.00	-2.05	2.36
SLR	xCd1	0	1	-0.86	0.36	0.62	-2.57	0.86	MSLR	xCd1	0	1	-3.96	0.87	0.07	-9.48	1.55
			2	-1.32	0.37	0.09	-3.08	0.44				2	-1.36	0.69	0.92	-5.67	2.94
			3	-1.62	0.35	0.01	-3.27	0.03				3	-1.07	0.57	0.95	-4.61	2.48
			4	-1.69*	0.26	0.00	-3.04	-0.35				4	-0.10	0.32	1.00	-1.89	1.69
			5	-1.87*	0.27	0.00	-3.22	-0.53				5	0.15	0.22	1.00	-0.96	1.25
			6	-2.29*	0.29	0.00	-3.66	-0.92				6	0.00	0.32	1.00	-1.81	1.80
			7	-2.26*	0.38	0.00	-4.08	-0.45				7	-0.54	0.29	0.95	-2.18	1.11
		1	2	-0.47	0.40	1.00	-2.35	1.42			1	2	2.60	1.10	0.63	-2.65	7.84

			3	-0.77	0.39	0.85	-2.57	1.04				3	2.90	1.04	0.37	-2.18	7.98
			4	-0.84	0.30	0.45	-2.49	0.82				4	3.86	0.92	0.07	-1.33	9.06
			5	-1.02	0.31	0.21	-2.65	0.62				5	4.11	0.89	0.05	-1.27	9.49
			6	-1.44	0.33	0.03	-3.07	0.20				6	3.96	0.92	0.06	-1.24	9.15
			7	-1.41	0.41	0.11	-3.34	0.52				7	3.43	0.91	0.13	-1.81	8.66
		2	3	-0.30	0.39	1.00	-2.14	1.54			2	3	0.30	0.89	1.00	-3.89	4.48
			4	-0.37	0.31	1.00	-2.09	1.35				4	1.27	0.74	0.97	-2.74	5.27
			5	-0.55	0.32	0.97	-2.25	1.15				5	1.51	0.71	0.85	-2.65	5.67
			6	-0.97	0.34	0.33	-2.66	0.72				6	1.36	0.75	0.95	-2.65	5.36
			7	-0.94	0.42	0.69	-2.90	1.02				7	0.83	0.74	1.00	-3.20	4.86
		3	4	-0.07	0.29	1.00	-1.63	1.48			3	4	0.97	0.64	0.99	-2.32	4.26
			5	-0.25	0.30	1.00	-1.79	1.29				5	1.21	0.60	0.89	-2.18	4.61
			6	-0.67	0.31	0.79	-2.21	0.87				6	1.06	0.64	0.98	-2.23	4.35
			7	-0.64	0.40	0.98	-2.53	1.24				7	0.53	0.63	1.00	-2.77	3.83
		4	5	-0.18	0.18	1.00	-1.01	0.65			4	5	0.25	0.35	1.00	-1.50	1.99
			6	-0.60	0.20	0.28	-1.58	0.39				6	0.09	0.42	1.00	-1.89	2.07
			7	-0.57	0.32	0.96	-2.36	1.22				7	-0.44	0.41	1.00	-2.34	1.46
		5	6	-0.42	0.22	0.88	-1.44	0.60			5	6	-0.15	0.36	1.00	-1.91	1.60
			7	-0.39	0.33	1.00	-2.16	1.38				7	-0.68	0.34	0.84	-2.31	0.94
		6	7	0.03	0.35	1.00	-1.73	1.78			6	7	-0.53	0.41	1.00	-2.44	1.38
	xCd2	0	1	-0.74	0.29	0.55	-2.29	0.81	MSLR	xCd2	0	1	-3.04	0.74	0.09	-7.43	1.35
			2	-1.43	0.31	0.04	-3.16	0.29				2	-0.96	0.49	0.90	-3.62	1.69
			3	-1.50*	0.21	0.00	-2.56	-0.45				3	-0.72	0.47	0.99	-3.24	1.80
			4	-1.74*	0.27	0.00	-3.15	-0.34				4	-0.20	0.36	1.00	-2.01	1.61
			5	-1.95*	0.28	0.00	-3.43	-0.47				5	-0.10	0.23	1.00	-1.22	1.02
			6	-3.00*	0.36	0.00	-5.04	-0.96				6	-0.17	0.24	1.00	-1.33	0.98
			7	-2.78*	0.29	0.00	-4.32	-1.25				7	-0.93	0.28	0.14	-2.26	0.39
		1	2	-0.69	0.39	0.95	-2.53	1.15			1	2	2.07	0.85	0.59	-2.12	6.26
			3	-0.76	0.32	0.61	-2.32	0.79				3	2.32	0.84	0.39	-1.86	6.50
			4	-1.00	0.36	0.33	-2.67	0.67				4	2.84	0.78	0.13	-1.38	7.05
			5	-1.21	0.36	0.14	-2.91	0.50				5	2.94	0.73	0.12	-1.56	7.43
			6	-2.25*	0.43	0.00	-4.30	-0.21				6	2.86	0.73	0.13	-1.59	7.32
			7	-2.04*	0.37	0.00	-3.78	-0.31				7	2.10	0.75	0.47	-2.25	6.46
		2	3	-0.07	0.34	1.00	-1.77	1.62			2	3	0.25	0.62	1.00	-2.67	3.16
			4	-0.31	0.38	1.00	-2.09	1.47				4	0.77	0.55	1.00	-1.89	3.43
			5	-0.52	0.38	1.00	-2.32	1.29				5	0.86	0.47	0.95	-1.88	3.61

			6	-1.57	0.45	0.10	-3.67	0.54				6	0.79	0.48	0.98	-1.92	3.50
			7	-1.35	0.39	0.10	-3.19	0.48				7	0.03	0.50	1.00	-2.61	2.67
		3	4	-0.24	0.30	1.00	-1.67	1.20			3	4	0.52	0.53	1.00	-2.03	3.07
			5	-0.44	0.31	1.00	-1.94	1.05				5	0.62	0.45	1.00	-1.98	3.22
			6	-1.49	0.38	0.07	-3.47	0.48				6	0.54	0.46	1.00	-2.02	3.11
			7	-1.28	0.32	0.04	-2.82	0.26				7	-0.21	0.48	1.00	-2.72	2.29
		4	5	-0.20	0.35	1.00	-1.83	1.42			4	5	0.10	0.34	1.00	-1.73	1.93
			6	-1.26	0.42	0.25	-3.26	0.75				6	0.02	0.35	1.00	-1.79	1.84
			7	-1.04	0.35	0.26	-2.70	0.62				7	-0.73	0.37	0.88	-2.56	1.09
		5	6	-1.05	0.42	0.54	-3.08	0.97			5	6	-0.07	0.20	1.00	-1.01	0.87
			7	-0.84	0.36	0.65	-2.54	0.86				7	-0.83	0.25	0.15	-2.05	0.39
		6	7	0.21	0.43	1.00	-1.83	2.26			6	7	-0.76	0.26	0.28	-2.00	0.48

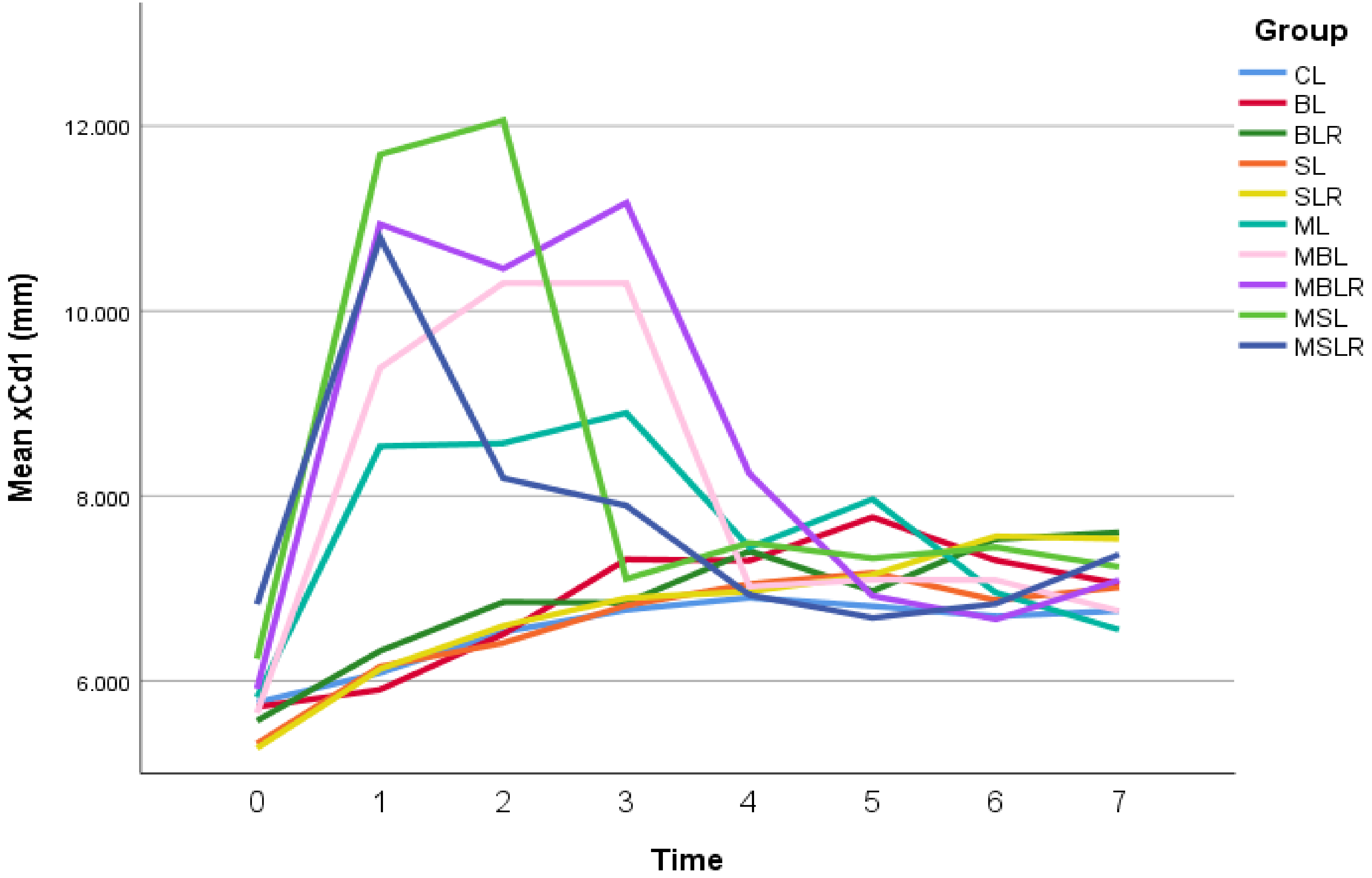


Figure 72: Line graph of mean lengths of xCd1 (mm) for DVC-LT groups at timepoints T0 to T7

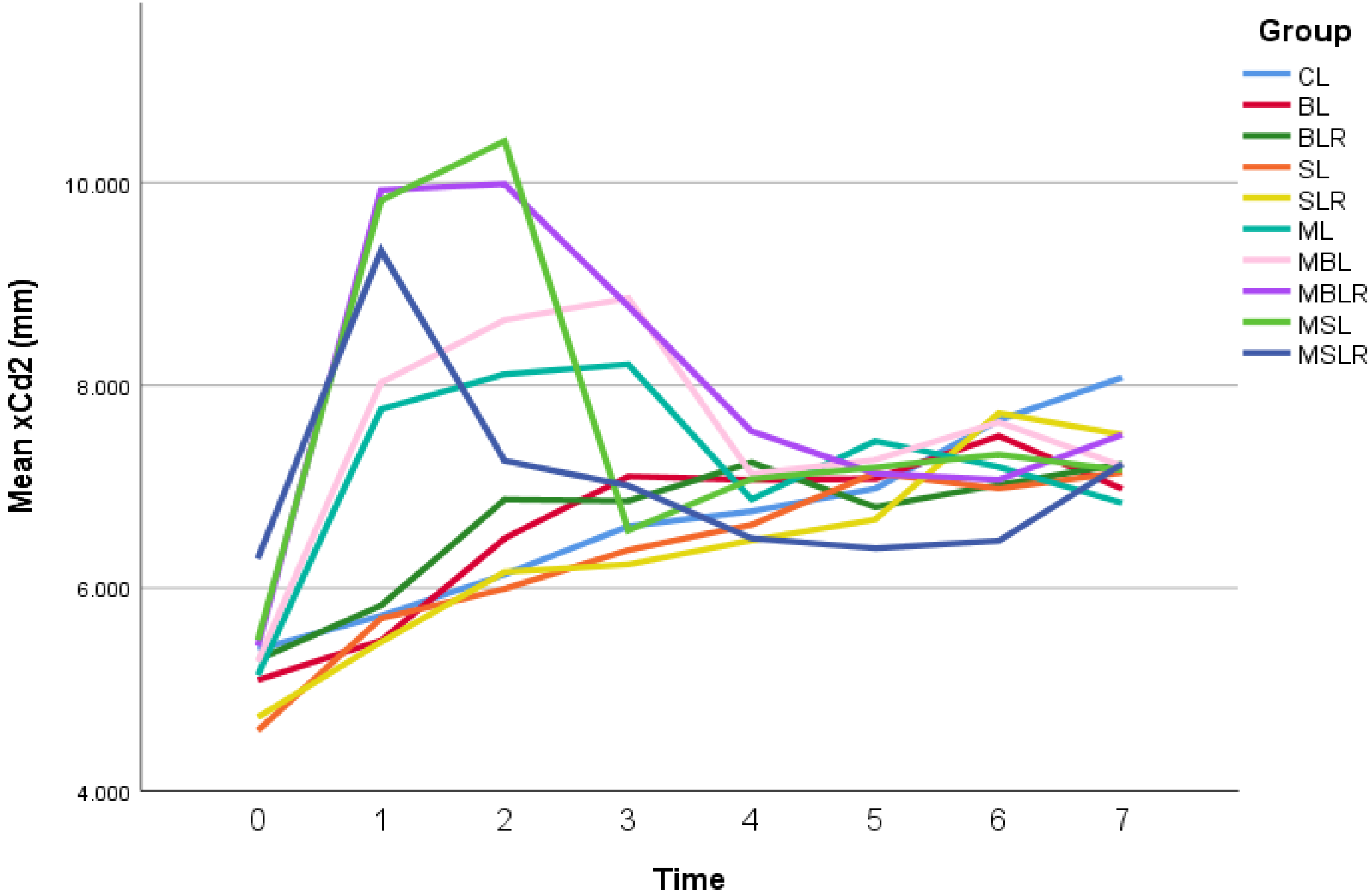


Figure 73: Line graph of mean lengths of xCd2 (mm) for DVC-LT groups at timepoints T0 to T7

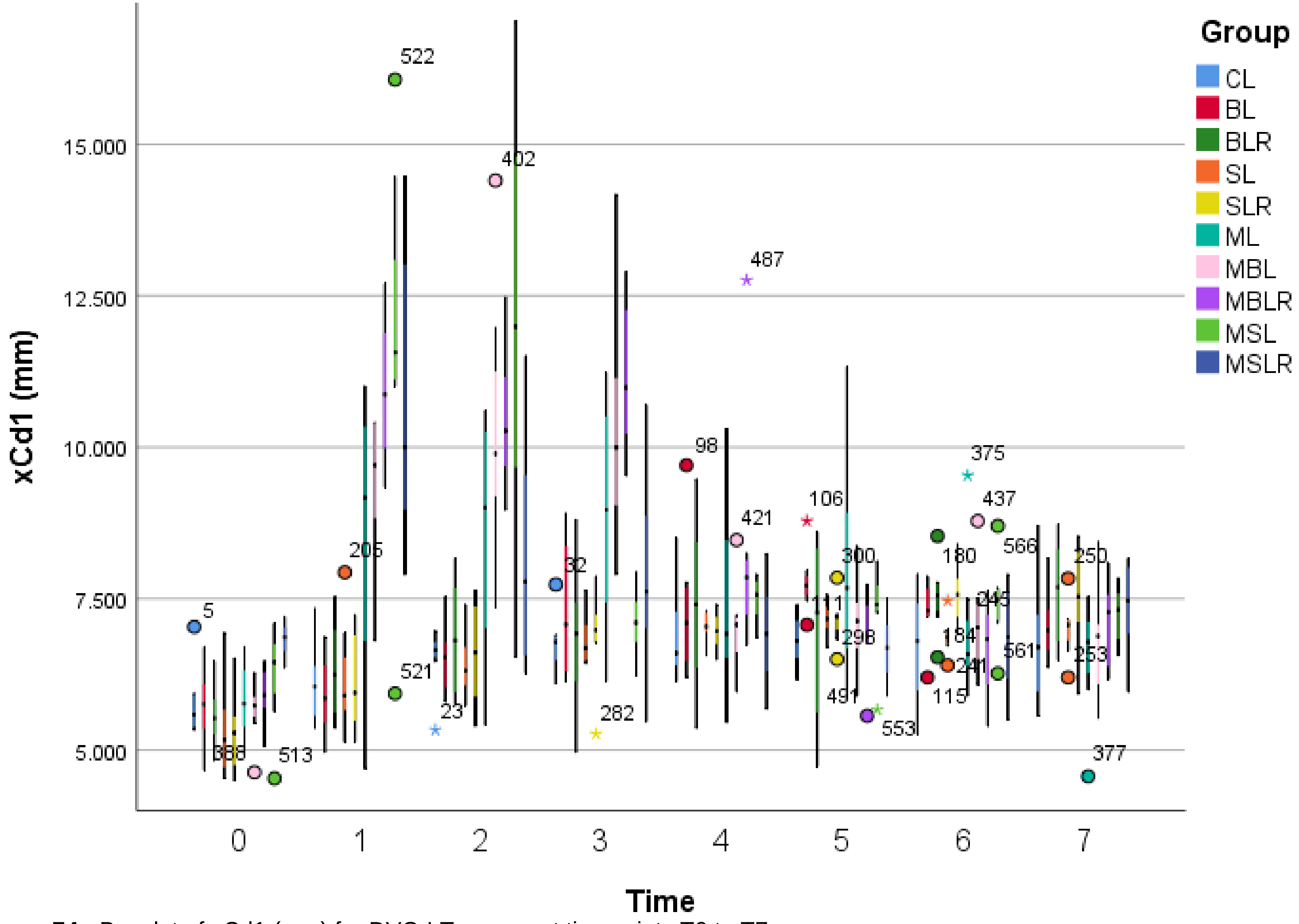


Figure 74: Boxplot of xCd1 (mm) for DVC-LT groups at timepoints T0 to T7

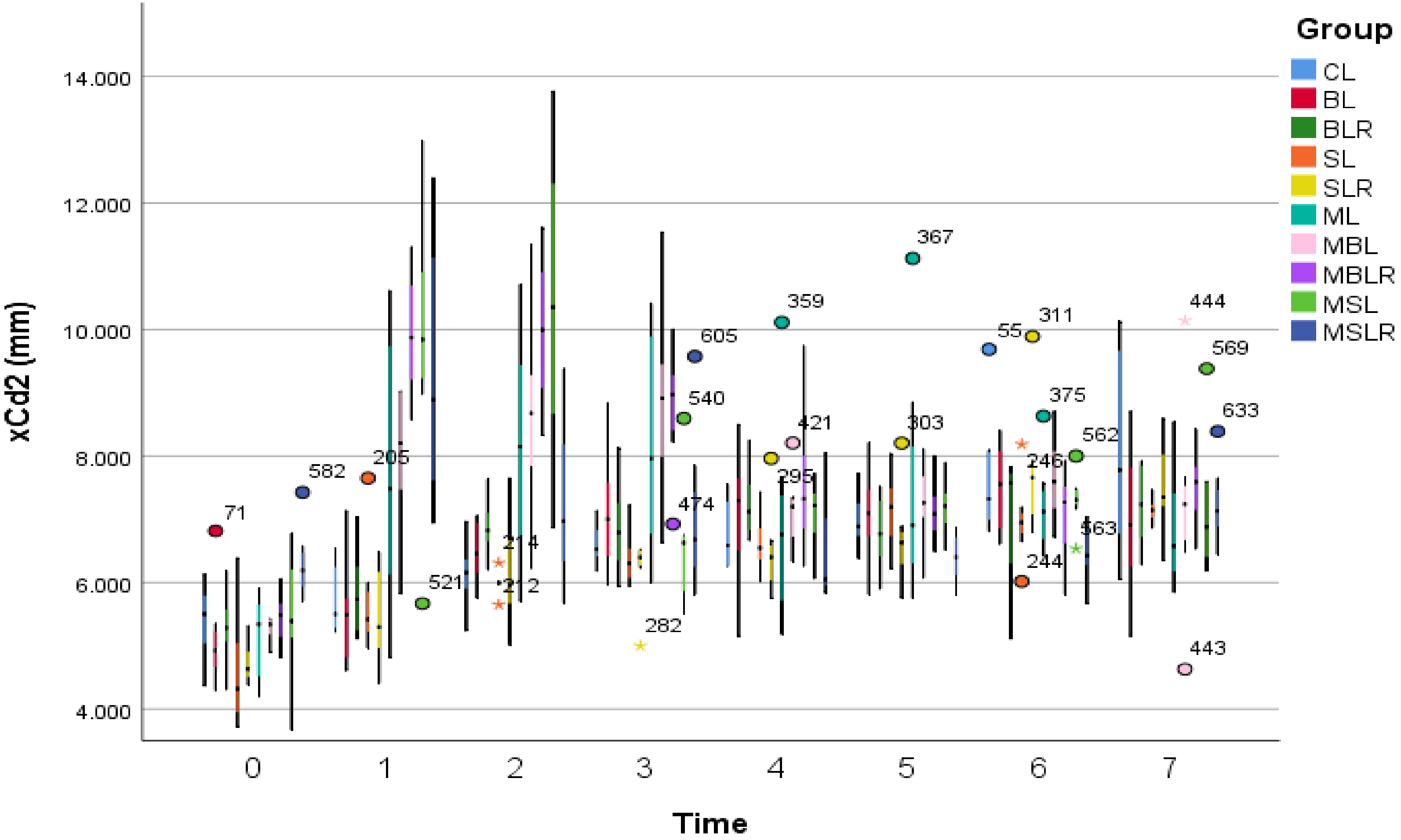


Figure 75: Boxplot of xCd2 (mm) for DVC-LT groups at timepoints T0 to T7

5.3.2.3 DVC-LT Intergonial Widths (Go1 to Go2)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Go1↔Go2 are displayed below (Table XLIII). A line graph of the group means and a boxplot of Go1↔Go2 are displayed below in Figures 76 and 77. At T0 there was no significant differences between the groups for intergonial widths (Go1↔Go2) for DVC-LT groups. At T1 the MBL group had a narrower intergonial width than the CL and SL groups ($p \leq 0.01$). At T2 the CL and SL groups had significantly wider intergonial widths than the BLR and ML groups ($p \leq 0.01$). The BLR group also had a narrower intergonial width than the SLR group ($p \leq 0.001$). At T3 the BLR group had a narrower intergonial width than the CL, BL, SL, and SLR groups ($p \leq 0.001$). The BL and BLR groups actually showed a reduction in intergonial width from T2 to T3. At T4 the BLR group had a narrower intergonial width than the CL, SL, and SLR groups ($p \leq 0.01$). At T5 the BLR group had a narrower intergonial width than the CL, SL, and SLR groups ($p \leq 0.001$) and actually showed a reduction in width from T4 to T5. The MBL group had a narrower intergonial width than the CL, SL, and SLR groups ($p \leq 0.001$). The MBLR group had a narrower intergonial width than the CL, SL, and SLR groups ($p \leq 0.001$). At T6 the BLR and MBLR groups had narrower intergonial widths than the SLR groups ($p \leq 0.01$). At T7 there was no significant differences between the groups for intergonial widths for DVC-LT groups.

Table XLIII: Multiple Comparisons Within Groups DVC-LT for Go1 to Go2

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.52	0.22	0.65	-1.62	0.58	ML	0	1	-0.30	0.28	1.00	-1.60	1.00
		2	-0.88	0.23	0.06	-1.99	0.23			2	-0.08	0.27	1.00	-1.36	1.20
		3	-1.06*	0.23	0.01	-2.17	0.05			3	-0.06	0.37	1.00	-1.88	1.75
		4	-1.25*	0.26	0.01	-2.47	-0.02			4	-0.15	0.27	1.00	-1.40	1.11
		5	-1.45*	0.24	0.00	-2.58	-0.33			5	-0.80	0.30	0.38	-2.20	0.59
		6	-1.43*	0.25	0.00	-2.60	-0.26			6	-1.40	0.33	0.03	-2.98	0.18
		7	-1.70*	0.26	0.00	-2.92	-0.48			7	-2.06*	0.21	0.00	-3.22	-0.90
	1	2	-0.36	0.17	0.80	-1.16	0.44		1	2	0.22	0.28	1.00	-1.07	1.51
		3	-0.54	0.17	0.19	-1.35	0.27			3	0.24	0.37	1.00	-1.58	2.05
		4	-0.73	0.21	0.14	-1.78	0.33			4	0.15	0.27	1.00	-1.11	1.42
		5	-0.94*	0.18	0.00	-1.79	-0.08			5	-0.50	0.30	0.97	-1.90	0.89
		6	-0.91	0.20	0.02	-1.86	0.05			6	-1.10	0.33	0.15	-2.69	0.49
		7	-1.18*	0.21	0.00	-2.23	-0.13			7	-1.76*	0.21	0.00	-2.94	-0.58
	2	3	-0.18	0.18	1.00	-1.04	0.67		2	3	0.01	0.36	1.00	-1.80	1.82

		4	-0.37	0.22	0.98	-1.44	0.71			4	-0.07	0.27	1.00	-1.32	1.18
		5	-0.58	0.19	0.22	-1.47	0.31			5	-0.73	0.29	0.54	-2.11	0.66
		6	-0.55	0.21	0.43	-1.53	0.43			6	-1.32	0.33	0.04	-2.90	0.26
		7	-0.82	0.22	0.07	-1.88	0.24			7	-1.98*	0.21	0.00	-3.12	-0.84
	3	4	-0.18	0.22	1.00	-1.26	0.89		3	4	-0.08	0.36	1.00	-1.89	1.73
		5	-0.40	0.19	0.81	-1.29	0.50			5	-0.74	0.38	0.89	-2.58	1.10
		6	-0.36	0.21	0.95	-1.35	0.62			6	-1.34	0.41	0.15	-3.26	0.59
		7	-0.64	0.22	0.31	-1.70	0.43			7	-1.99*	0.32	0.01	-3.91	-0.08
	4	5	-0.21	0.23	1.00	-1.31	0.88		4	5	-0.66	0.29	0.68	-2.03	0.71
		6	-0.18	0.24	1.00	-1.32	0.96			6	-1.25	0.32	0.06	-2.82	0.32
		7	-0.45	0.26	0.94	-1.65	0.74			7	-1.91*	0.20	0.00	-3.01	-0.82
	5	6	0.03	0.21	1.00	-0.98	1.04		5	6	-0.60	0.35	0.96	-2.23	1.04
		7	-0.24	0.23	1.00	-1.33	0.84			7	-1.25	0.23	0.02	-2.60	0.09
	6	7	-0.27	0.24	1.00	-1.41	0.86		6	7	-0.66	0.28	0.72	-2.28	0.97
BL	0	1	-0.45	0.37	1.00	-2.20	1.29	MBL	0	1	0.00	0.16	1.00	-0.74	0.74
		2	-0.27	0.38	1.00	-2.05	1.50			2	-0.53	0.13	0.05	-1.19	0.12
		3	-0.28	0.36	1.00	-2.02	1.46			3	0.39	0.24	0.98	-0.82	1.61
		4	-0.94	0.42	0.69	-2.90	1.01			4	-0.38	0.14	0.41	-1.05	0.29
		5	-0.98	0.43	0.67	-3.00	1.04			5	-0.44	0.16	0.38	-1.20	0.32
		6	-1.33	0.37	0.09	-3.09	0.44			6	-1.67*	0.26	0.00	-3.03	-0.30
		7	-1.90*	0.33	0.00	-3.59	-0.21			7	-2.15*	0.18	0.00	-3.00	-1.31
	1	2	0.18	0.33	1.00	-1.34	1.71		1	2	-0.53	0.13	0.05	-1.19	0.12
		3	0.17	0.31	1.00	-1.29	1.64			3	0.39	0.24	0.98	-0.82	1.61
		4	-0.49	0.38	1.00	-2.28	1.31			4	-0.38	0.14	0.41	-1.05	0.29
		5	-0.53	0.39	1.00	-2.41	1.36			5	-0.44	0.16	0.38	-1.20	0.32
		6	-0.87	0.32	0.39	-2.39	0.64			6	-1.67*	0.26	0.00	-3.03	-0.30
		7	-1.45*	0.28	0.01	-2.77	-0.12			7	-2.15*	0.18	0.00	-3.00	-1.31
	2	3	-0.01	0.32	1.00	-1.53	1.51		2	3	0.93	0.22	0.07	-0.32	2.18
		4	-0.67	0.38	0.95	-2.49	1.15			4	0.16	0.11	1.00	-0.37	0.69
		5	-0.71	0.40	0.94	-2.61	1.19			5	0.10	0.14	1.00	-0.59	0.78
		6	-1.06	0.33	0.17	-2.62	0.50			6	-1.13	0.24	0.04	-2.54	0.28
		7	-1.63*	0.29	0.00	-3.03	-0.23			7	-1.62*	0.16	0.00	-2.43	-0.81
	3	4	-0.66	0.37	0.95	-2.45	1.13		3	4	-0.77	0.23	0.19	-2.01	0.46
		5	-0.70	0.39	0.94	-2.57	1.18			5	-0.83	0.24	0.14	-2.05	0.38
		6	-1.05	0.32	0.15	-2.55	0.45			6	-2.06*	0.31	0.00	-3.53	-0.59
		7	-1.62*	0.27	0.00	-2.93	-0.31			7	-2.55*	0.25	0.00	-3.78	-1.32

	4	5	-0.04	0.44	1.00	-2.09	2.01		4	5	-0.06	0.14	1.00	-0.76	0.63
		6	-0.39	0.38	1.00	-2.20	1.43			6	-1.29	0.25	0.02	-2.68	0.10
		7	-0.96	0.34	0.39	-2.71	0.79			7	-1.78*	0.16	0.00	-2.59	-0.96
	5	6	-0.35	0.39	1.00	-2.24	1.55		5	6	-1.23	0.26	0.02	-2.59	0.13
		7	-0.92	0.36	0.53	-2.77	0.93			7	-1.72*	0.18	0.00	-2.58	-0.86
	6	7	-0.57	0.28	0.85	-1.95	0.80		6	7	-0.49	0.27	0.95	-1.85	0.87
BLR	0	1	0.05	0.18	1.00	-0.92	1.03	MBLR	0	1	0.00	0.22	1.00	-1.02	1.02
		2	-0.06	0.10	1.00	-0.52	0.41			2	-0.76	0.22	0.10	-1.79	0.26
		3	0.15	0.14	1.00	-0.57	0.87			3	0.57	0.22	0.49	-0.48	1.61
		4	0.00	0.12	1.00	-0.61	0.61			4	-0.36	0.21	0.96	-1.35	0.62
		5	-0.46	0.16	0.43	-1.33	0.42			5	-0.18	0.20	1.00	-1.11	0.75
		6	-0.92*	0.10	0.00	-1.38	-0.45			6	-0.91	0.23	0.04	-1.99	0.16
		7	-1.47*	0.10	0.00	-1.92	-1.03			7	-1.86*	0.18	0.00	-2.75	-0.96
	1	2	-0.11	0.18	1.00	-1.08	0.86		1	2	-0.76	0.22	0.10	-1.79	0.26
		3	0.10	0.21	1.00	-0.89	1.08			3	0.57	0.22	0.49	-0.48	1.61
		4	-0.05	0.20	1.00	-1.02	0.91			4	-0.36	0.21	0.96	-1.35	0.62
		5	-0.51	0.22	0.67	-1.55	0.54			5	-0.18	0.20	1.00	-1.11	0.75
		6	-0.97*	0.18	0.01	-1.94	0.00			6	-0.91	0.23	0.04	-1.99	0.16
		7	-1.53*	0.18	0.00	-2.50	-0.55			7	-1.86*	0.18	0.00	-2.75	-0.96
	2	3	0.20	0.14	1.00	-0.52	0.93		2	3	1.33*	0.22	0.00	0.28	2.38
		4	0.06	0.13	1.00	-0.56	0.67			4	0.40	0.21	0.90	-0.59	1.39
		5	-0.40	0.17	0.65	-1.27	0.47			5	0.58	0.20	0.26	-0.35	1.51
		6	-0.86*	0.10	0.00	-1.34	-0.38			6	-0.15	0.23	1.00	-1.23	0.92
		7	-1.42*	0.10	0.00	-1.88	-0.96			7	-1.09*	0.18	0.00	-2.00	-0.19
	3	4	-0.15	0.16	1.00	-0.91	0.62		3	4	-0.93	0.22	0.02	-1.94	0.08
		5	-0.60	0.19	0.20	-1.52	0.31			5	-0.75	0.20	0.07	-1.71	0.22
		6	-1.07*	0.14	0.00	-1.79	-0.35			6	-1.48*	0.23	0.00	-2.58	-0.39
		7	-1.62*	0.14	0.00	-2.34	-0.90			7	-2.42*	0.19	0.00	-3.36	-1.48
	4	5	-0.46	0.18	0.54	-1.34	0.43		4	5	0.18	0.19	1.00	-0.70	1.06
		6	-0.92*	0.13	0.00	-1.54	-0.30			6	-0.55	0.22	0.52	-1.59	0.49
		7	-1.47*	0.12	0.00	-2.08	-0.86258			7	-1.49*	0.17	0.00	-2.33	-0.66
	5	6	-0.46	0.17	0.42	-1.34	0.41		5	6	-0.73	0.21	0.10	-1.73	0.27
		7	-1.02*	0.16	0.00	-1.89	-0.14			7	-1.67*	0.15	0.00	-2.39	-0.96
	6	7	-0.55*	0.10	0.00	-1.01	-0.10		6	7	-0.94	0.19	0.01	-1.92	0.04
SL	0	1	-0.64	0.21	0.27	-1.73	0.45	MSL	0	1	0.00	0.46	1.00	-2.16	2.16
		2	-1.03	0.23	0.02	-2.13	0.07			2	-0.99	0.40	0.57	-2.92	0.95

		3	-1.06*	0.20	0.01	-2.15	0.04			3	-0.78	0.36	0.79	-2.70	1.13
		4	-1.52*	0.20	0.00	-2.61	-0.42			4	-1.21	0.36	0.19	-3.12	0.71
		5	-1.74*	0.20	0.00	-2.83	-0.64			5	-1.61	0.39	0.04	-3.53	0.31
		6	-1.65*	0.23	0.00	-2.76	-0.55			6	-2.02*	0.44	0.01	-4.08	0.04
		7	-1.92*	0.24	0.00	-3.05	-0.80			7	-2.39*	0.35	0.00	-4.31	-0.46
		2	-0.39	0.16	0.59	-1.16	0.39			2	-0.99	0.40	0.57	-2.92	0.95
		3	-0.41	0.13	0.14	-1.00	0.17			3	-0.78	0.36	0.79	-2.70	1.13
	1	4	-0.88*	0.12	0.00	-1.45	-0.30		1	4	-1.21	0.36	0.19	-3.12	0.71
		5	-1.09*	0.13	0.00	-1.68	-0.51			5	-1.61	0.39	0.04	-3.53	0.31
		6	-1.01*	0.16	0.00	-1.80	-0.22			6	-2.02*	0.44	0.01	-4.08	0.04
		7	-1.28*	0.17	0.00	-2.12	-0.44			7	-2.39*	0.35	0.00	-4.31	-0.46
		3	-0.03	0.16	1.00	-0.79	0.74			3	0.20	0.28	1.00	-1.16	1.56
		4	-0.49	0.15	0.21	-1.25	0.28			4	-0.22	0.27	1.00	-1.58	1.14
	2	5	-0.71	0.16	0.02	-1.47	0.06		2	5	-0.63	0.32	0.87	-2.12	0.87
		6	-0.62	0.19	0.13	-1.50	0.25			6	-1.04	0.38	0.36	-2.82	0.74
		7	-0.89*	0.19	0.01	-1.80	0.02			7	-1.40*	0.27	0.01	-2.76	-0.05
		4	-0.46	0.12	0.04	-1.01	0.09			4	-0.42	0.21	0.83	-1.39	0.55
	3	5	-0.68*	0.12	0.00	-1.24	-0.12		3	5	-0.83	0.26	0.21	-2.12	0.46
		6	-0.60	0.16	0.07	-1.38	0.18			6	-1.24	0.33	0.09	-2.95	0.47
		7	-0.87*	0.17	0.01	-1.70	-0.03			7	-1.60*	0.20	0.00	-2.53	-0.67
		5	-0.22	0.12	0.92	-0.77	0.33			5	-0.41	0.26	0.99	-1.69	0.88
	4	6	-0.13	0.16	1.00	-0.91	0.65		4	6	-0.82	0.33	0.59	-2.53	0.90
		7	-0.40	0.17	0.61	-1.24	0.43			7	-1.19*	0.20	0.00	-2.10	-0.26
	5	6	0.08	0.16	1.00	-0.70	0.86		5	6	-0.41	0.37	1.00	-2.17	1.34
		7	-0.19	0.17	1.00	-1.02	0.65			7	-0.77	0.26	0.27	-2.05	0.50
	6	7	-0.27	0.20	1.00	-1.19	0.65		6	7	-0.36	0.32	1.00	-2.09	1.36
		1	-0.64	0.29	0.76	-2.06	0.78			1	0.00	0.43	1.00	-2.00	2.00
		2	-1.09	0.26	0.06	-2.52	0.34			2	-0.58	0.33	0.97	-2.36	1.21
		3	-1.20	0.26	0.03	-2.62	0.22			3	-0.54	0.43	1.00	-2.53	1.45
	0	4	-1.45*	0.25	0.01	-2.93	0.02		0	4	-0.78	0.45	0.96	-2.88	1.32
SLR		5	-1.99*	0.29	0.00	-3.42	-0.58	MSLR		5	-1.21	0.45	0.38	-3.31	0.88
		6	-2.11*	0.29	0.00	-3.52	-0.71			6	-1.37	0.35	0.06	-3.13	0.39
		7	-2.46*	0.32	0.00	-3.95	-0.97			7	-1.84*	0.33	0.01	-3.61	-0.06
		2	-0.45	0.19	0.67	-1.43	0.53			2	-0.58	0.33	0.97	-2.36	1.21
	1	3	-0.56	0.19	0.33	-1.54	0.42		1	3	-0.54	0.43	1.00	-2.53	1.45
		4	-0.81	0.18	0.04	-1.81	0.19			4	-0.78	0.45	0.96	-2.88	1.32

		5	-1.36*	0.24	0.00	-2.47	-0.25			5	-1.21	0.45	0.38	-3.31	0.88
		6	-1.47*	0.23	0.00	-2.55	-0.40			6	-1.37	0.35	0.06	-3.13	0.39
		7	-1.82*	0.27	0.00	-3.08	-0.56			7	-1.84*	0.33	0.01	-3.61	-0.06
	2	3	-0.11	0.13	1.00	-0.73	0.50		2	3	0.04	0.33	1.00	-1.72	1.80
		4	-0.37	0.11	0.13	-0.89	0.15			4	-0.20	0.35	1.00	-2.17	1.76
		5	-0.91	0.19	0.02	-1.89	0.07			5	-0.64	0.35	0.95	-2.58	1.31
		6	-1.03*	0.18	0.00	-1.93	-0.12			6	-0.79	0.21	0.07	-1.81	0.23
		7	-1.37*	0.23	0.00	-2.59	-0.15			7	-1.26*	0.19	0.00	-2.15	-0.38
	3	4	-0.25	0.12	0.76	-0.82	0.31		3	4	-0.24	0.45	1.00	-2.33	1.85
		5	-0.80	0.19	0.05	-1.78	0.18			5	-0.68	0.44	0.99	-2.76	1.41
		6	-0.91*	0.18	0.01	-1.82	0.00			6	-0.83	0.34	0.62	-2.57	0.91
		7	-1.26*	0.23	0.01	-2.47	-0.04			7	-1.30	0.33	0.08	-3.05	0.45
	4	5	-0.54	0.18	0.34	-1.55	0.46		4	5	-0.44	0.47	1.00	-2.61	1.74
		6	-0.66	0.17	0.09	-1.58	0.27			6	-0.59	0.37	0.99	-2.52	1.34
		7	-1.01	0.22	0.04	-2.26	0.25			7	-1.06	0.36	0.36	-3.01	0.89
	5	6	-0.11	0.23	1.00	-1.19	0.96		5	6	-0.15	0.37	1.00	-2.07	1.76
		7	-0.46	0.27	0.96	-1.73	0.80			7	-0.62	0.36	0.97	-2.55	1.31
	6	7	-0.35	0.26	1.00	-1.59	0.90		6	7	-0.47	0.22	0.78	-1.51	0.57

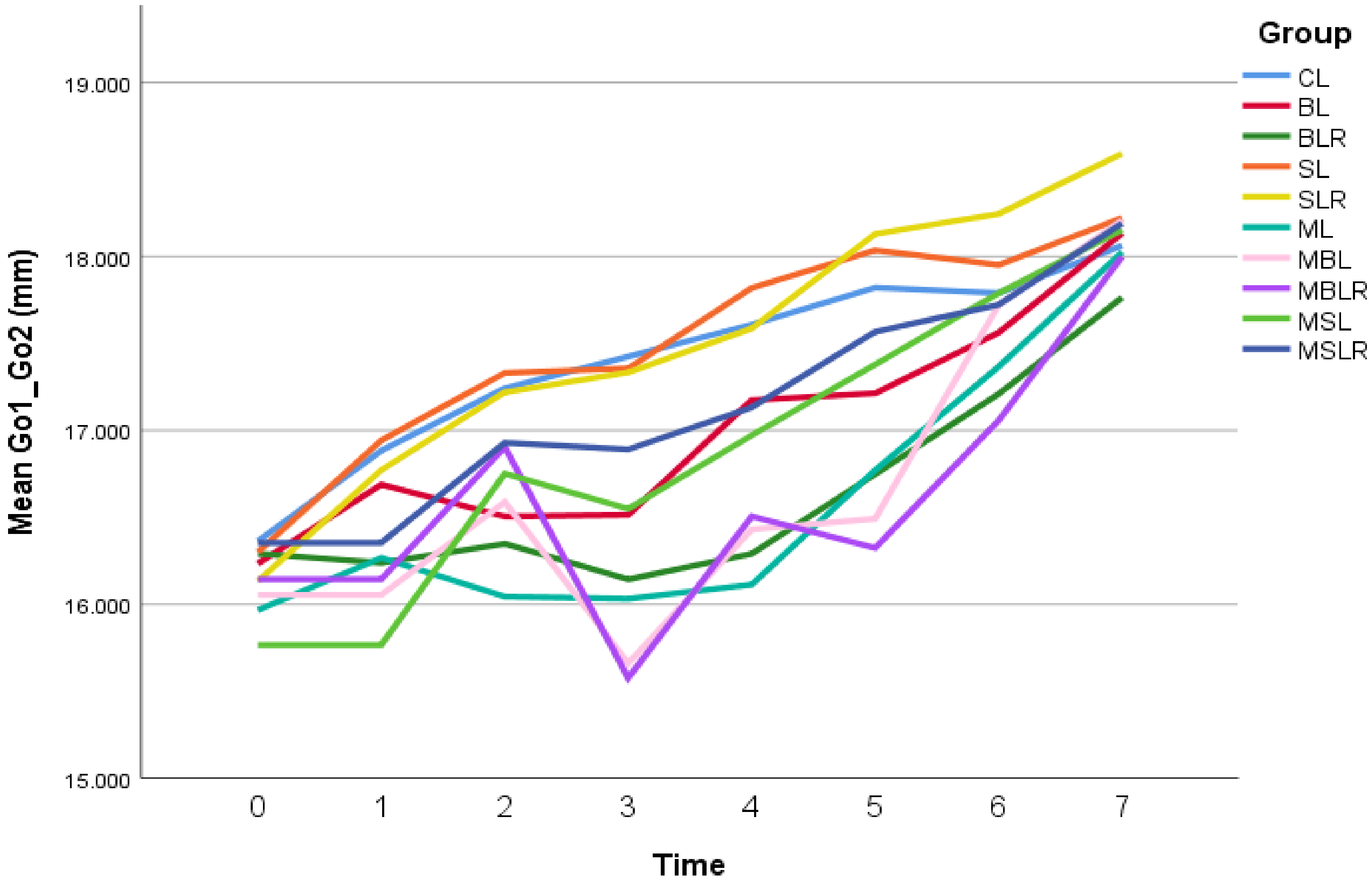


Figure 76: Line graph of mean lengths of Go1↔Go2 (mm) for DVC-LT groups at timepoints T0 to T7

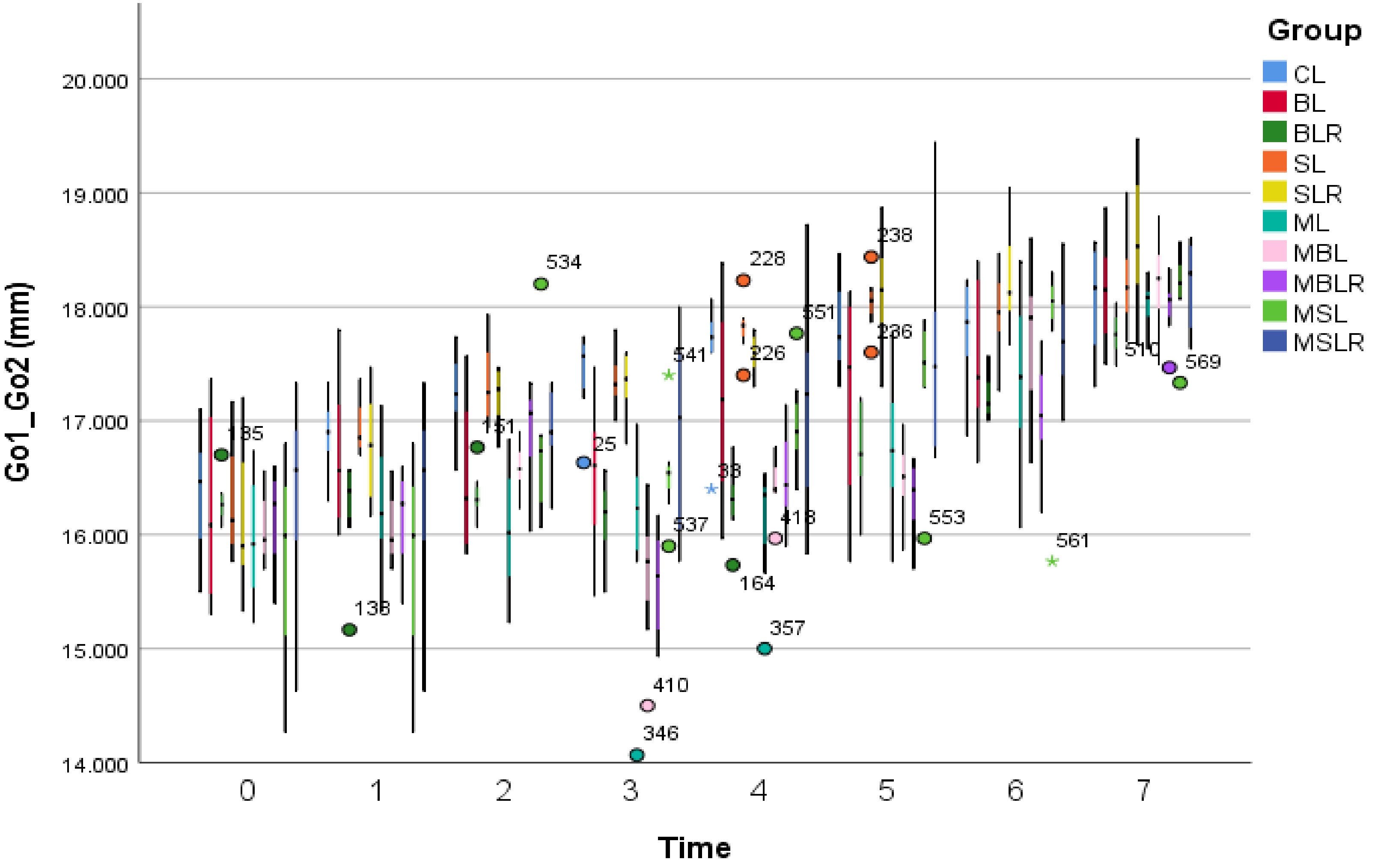


Figure 77: Boxplot of Go1↔Go2 (mm) for DVC-LT groups at timepoints T0 to T7

5.3.2.4 DVC-LT Intercoronoid Widths (Cd1 to Cd2)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Cd1↔Cd2 are displayed below (Table XLIV). A line graph of the group means and a boxplot of Cd1↔Cd2 are displayed below in Figures 78 and 79. T0 there was no significant differences between the groups for intercoronoid widths (Cd1↔Cd2) for DVC-LT groups. At T1 and T2 the MBLR group had significantly narrower intercoronoid width than the CL group ($p \leq 0.01$). At T3 the BLR group had significantly narrower intercoronoid width than the CL group ($p \leq 0.001$). The MBL group had significantly narrower intercoronoid width than the CL and SLR groups ($p \leq 0.01$). The MBLR group had significantly narrower intercoronoid width than the CL and SLR groups ($p \leq 0.01$). At T4 the BLR group had significantly narrower intercoronoid widths than the CL, SL, and SLR groups ($p \leq 0.001$). The MBL group had significantly narrower intercoronoid widths than the CL, SLR, and MSL groups ($p \leq 0.01$). At T5 the BLR group had significantly narrower intercoronoid width than the CL group and SLR groups ($p \leq 0.001$). The MBL group had significantly narrower intercoronoid width than the CL, SLR and MSL groups ($p \leq 0.01$). The MBLR group had significantly narrower intercoronoid width than the CL group ($p \leq 0.01$). At T6 the BLR group had significantly narrower intercoronoid width than the CL group and SLR groups ($p \leq 0.001$). At T7 the BLR group had significantly narrower intercoronoid width than the CL group ($p \leq 0.001$).

Table XLIV: Multiple Comparisons Within Groups DVC-LT for Cd1 to Cd2

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.59	0.24	0.54	-1.73	0.54	ML	0	1	0.06	0.49	1.00	-2.57	2.68
		2	-1.20*	0.25	0.01	-2.39	-0.02			2	-0.38	0.50	1.00	-030	2.24
		3	-1.64*	0.21	0.00	-2.75	-0.54			3	-0.89	0.50	0.96	-3.51	1.72
		4	-1.89*	0.25	0.00	-3.08	-0.71			4	-0.99	0.51	0.90	-3.60	1.62
		5	-2.81*	0.20	0.00	-3.93	-1.7			5	-1.58	0.49	0.24	-4.21	1.05
		6	-3.35*	0.22	0.00	-4.46	-2.26			6	-2.41	0.49	0.02	-5.04	0.22
		7	-3.94*	0.20	0.00	-5.07	-2.83			7	-3.24*	0.48	0.00	-5.90	-0.58
	1	2	-0.61	0.22	0.35	-1.65	0.43		1	2	-0.44	0.30	0.99	-1.84	0.96
		3	-1.05*	0.17	0.00	-1.9	-0.21			3	-0.95	0.30	0.19	-2.38	0.48
		4	-1.30*	0.22	0.00	-2.34	-0.26			4	-1.05	0.32	0.14	-2.53	0.44
		5	-2.22*	0.16	0.00	-3.07	-1.38			5	-1.63*	0.29	0.00	-2.98	-0.29
		6	-2.77*	0.18	0.00	-3.63	-1.9			6	-2.47*	0.29	0.00	-3.81	-1.13
		7	-3.35*	0.16	0.00	-4.2	-2.51			7	-3.29*	0.27	0.00	-4.57	-2.03
	2	3	-0.44	0.19	0.68	-1.42	0.53		2	3	-0.51	0.31	0.98	-1.97	0.95

		4	-0.69	0.24	0.27	-1.80	0.41
		5	-1.60*	0.18	0.00	-2.59	-0.63
		6	-2.15*	0.20	0.00	-3.13	-1.18
		7	-2.74*	0.18	0.00	-3.73	-1.76
	3	4	-0.25	0.19	1.00	-1.22	0.72
		5	-1.16*	0.11	0.00	-1.70	-0.63
		6	-1.71*	0.14	0.00	-2.36	-1.07
		7	-2.30*	0.11	0.00	-2.82	-1.78
	4	5	-0.92	0.18	0.02	-1.89	0.06
		6	-1.46*	0.20	0.00	-2.44	-0.49
		7	-2.05*	0.18	0.00	-3.03	-1.07
	5	6	-0.55	0.13	0.03	-1.18	0.08
		7	-1.13*	0.10	0.00	-1.62	-0.64
	6	7	-0.59	0.13	0.02	-1.21	0.04
BL	0	1	-0.66	0.36	0.93	-2.43	1.10
		2	-0.90	0.37	0.59	-2.68	0.88
		3	-1.04	0.35	0.29	-2.78	0.70
		4	-1.40	0.44	0.16	-3.44	0.64
		5	-1.50	0.39	0.05	-3.32	0.33
		6	-1.98*	0.40	0.01	-3.85	-0.12
		7	-2.60*	0.47	0.00	-4.80	-0.41
	1	2	-0.24	0.30	1.00	-1.65	1.18
		3	-0.37	0.27	1.00	-1.65	0.90
		4	-0.73	0.38	0.89	-2.59	1.12
		5	-0.83	0.32	0.45	-2.34	0.68
		6	-1.32	0.33	0.04	-2.90	0.25
		7	-1.94	0.41	0.02	-4.02	0.14
	2	3	-0.14	0.28	1.00	-1.48	1.20
		4	-0.50	0.39	1.00	-2.37	1.37
		5	-0.60	0.33	0.93	-2.14	0.95
		6	-1.09	0.34	0.17	-2.70	0.52
		7	-1.70	0.42	0.05	-3.79	0.38
	3	4	-0.36	0.36	1.00	-2.20	1.48
		5	-0.46	0.30	0.99	-1.91	0.99
		6	-0.95	0.31	0.25	-2.48	0.58
		7	-1.57	0.40	0.07	-3.65	0.52

		4	-0.61	0.32	0.91	-2.12	0.91
		5	-1.19	0.30	0.04	-2.58	0.19
		6	-2.03*	0.30	0.00	-3.42	-0.65
		7	-2.86*	0.28	0.00	-4.18	-1.54
	3	4	-0.10	0.33	1.00	-1.63	1.44
		5	-0.68	0.30	0.69	-2.10	0.73
		6	-1.51*	0.30	0.01	-2.93	-0.11
		7	-2.35*	0.28	0.00	-3.70	-0.99
	4	5	-0.59	0.31	0.91	-2.07	0.89
		6	-1.42*	0.31	0.01	-2.9	0.05
		7	-2.25*	0.30	0.00	-3.68	-0.83
	5	6	-0.84	0.28	0.26	-2.16	0.49
		7	-1.66*	0.27	0.00	-2.92	-0.41
	6	7	-0.83	0.27	0.19	-2.07	0.42
MBL	0	1	0.55	0.15	0.12	-0.24	1.35
		2	0.34	0.24	1.00	-1.06	1.75
		3	0.24	0.24	1.00	-1.13	1.60
		4	-0.55*	0.11	0.01	-1.09	-0.02
		5	-0.75	0.16	0.02	-1.60	0.10
		6	-2.56*	0.34	0.00	-4.65	-0.48
		7	-2.84*	0.27	0.00	-4.44	-1.24
	1	2	-0.21	0.27	1.00	-1.56	1.15
		3	-0.32	0.26	1.00	-1.64	1.00
		4	-1.11*	0.16	0.00	-1.91	-0.31
		5	-1.30*	0.2	0.00	-2.24	-0.37
		6	-3.11*	0.36	0.00	-5.10	-1.14
		7	-3.34*	0.30	0.00	-4.92	-1.87
	2	3	-0.11	0.32	1.00	-1.63	1.41
		4	-0.90	0.25	0.14	-2.29	0.48
		5	-1.09	0.27	0.05	-2.45	0.26
		6	-2.90*	0.41	0.00	-4.89	-0.93
		7	-3.18*	0.35	0.00	-4.83	-1.54
	3	4	-0.79	0.24	0.24	-2.14	0.55
		5	-0.99	0.27	0.09	-2.31	0.34
		6	-2.80*	0.40	0.00	-4.77	-0.83
		7	-3.07*	0.35	0.00	-4.71	-1.45

	4	5	-0.10	0.40	1.00	-2.01	1.81
		6	-0.59	0.41	1.00	-2.53	1.35
		7	-1.21	0.48	0.50	-3.45	1.04
	5	6	-0.49	0.36	1.00	-2.16	1.18
		7	-1.11	0.43	0.50	-3.21	1.00
	6	7	-0.62	0.44	1.00	-2.74	1.51
BLR	0	1	-0.15	0.14	1.00	-0.84	0.54
		2	-0.74*	0.09	0.00	-1.19	-0.30
		3	-0.56	0.14	0.04	-1.23	0.12
		4	-0.50	0.17	0.35	-1.40	0.41
		5	-0.96*	0.18	0.01	-1.92	0.00
		6	-1.57*	0.15	0.00	-2.33	-0.83
		7	-2.55*	0.12	0.00	-3.13	-1.98
	1	2	-0.60	0.13	0.03	-1.29	0.09
		3	-0.41	0.17	0.55	-1.18	0.37
		4	-0.35	0.19	0.94	-1.28	0.58
		5	-0.81	0.20	0.04	-1.78	0.16
		6	-1.42*	0.18	0.00	-2.25	-0.61
		7	-2.40*	0.15	0.00	-3.13	-1.68
	2	3	0.19	0.13	1.00	-0.49	0.86
		4	0.25	0.17	1.00	-0.66	1.16
		5	-0.21	0.18	1.00	-1.19	0.76
		6	-0.83*	0.14	0.01	-1.59	-0.08
		7	-1.80*	0.12	0.00	-2.38	-1.24
	3	4	0.06	0.19	1.00	-0.86	0.98
		5	-0.40	0.20	0.86	-1.37	0.57
		6	-1.02*	0.17	0.00	-1.84	-0.21
		7	-1.99*	0.15	0.00	-2.71	-1.28
	4	5	-0.46	0.23	0.82	-1.52	0.59
		6	-1.08*	0.20	0.00	-2.03	-0.13
		7	-2.05*	0.18	0.00	-2.96	-1.15
	5	6	-0.62	0.21	0.26	-1.61	0.37
		7	-1.59*	0.19	0.00	-2.55	-0.64
	6	7	-0.97*	0.16	0.00	-1.75	-0.20
SL	0	1	-0.45	0.20	0.69	-1.38	0.48
		2	-0.92*	0.19	0.01	-1.81	-0.05

	4	5	-0.19	0.17	1.00	-1.04	0.65
		6	-2.01*	0.35	0.01	-4.07	0.05
		7	-2.28*	0.28	0.00	-3.86	-0.71
	5	6	-1.82	0.37	0.02	-3.79	0.16
		7	-2.09*	0.30	0.00	-3.62	-0.57
	6	7	-0.28	0.43	1.00	-2.30	1.75
MBLR	0	1	0.88	0.22	0.04	-0.15	1.92
		2	0.38	0.24	0.99	-0.77	1.54
		3	0.32	0.25	1.00	-0.84	1.49
		4	-0.68	0.23	0.27	-1.79	0.42
		5	-0.77	0.27	0.31	-2.05	0.52
		6	-1.75*	0.27	0.00	-3.04	-0.46
		7	-2.23*	0.20	0.00	-3.18	-1.30
	1	2	-0.50	0.25	0.84	-1.66	0.67
		3	-0.56	0.25	0.70	-1.73	0.62
		4	-1.56*	0.24	0.00	-2.68	-0.45
		5	-1.64*	0.27	0.00	-2.94	-0.36
		6	-2.63*	0.27	0.00	-3.93	-1.34
		7	-3.11*	0.20	0.00	-4.07	-2.16
	2	3	-0.06	0.27	1.00	-1.32	1.20
		4	-1.07	0.26	0.03	-2.28	0.14
		5	-1.15	0.29	0.04	-2.50	0.20
		6	-2.13*	0.29	0.00	-3.49	-0.78
		7	-2.62*	0.23	0.00	-3.73	-1.51
	3	4	-1.01	0.26	0.05	-2.23	0.21
		5	-1.09	0.29	0.06	-2.45	0.27
		6	-2.07*	0.29	0.00	-3.44	-0.72
		7	-2.56*	0.23	0.00	-3.68	-1.44
	4	5	-0.08	0.28	1.00	-1.40	1.24
		6	-1.07	0.28	0.06	-2.39	0.26
		7	-1.55*	0.22	0.00	-2.59	-0.51
	5	6	-0.99	0.31	0.16	-2.42	0.45
		7	-1.47*	0.25	0.00	-2.73	-0.21
	6	7	-0.48	0.25	0.90	-1.75	0.78
MSL	0	1	1.15	0.27	0.07	-0.43	2.74
		2	0.81	0.30	0.53	-0.99	2.62

		3	-1.05*	0.19	0.00	-1.93	-0.17
		4	-1.94*	0.22	0.00	-3	-0.89
		5	-2.38*	0.28	0.00	-3.77	-0.10
		6	-2.83*	0.33	0.00	-4.59	-1.08
		7	-3.68*	0.26	0.00	-4.95	-2.42
	1	2	-0.48	0.18	0.43	-1.33	0.38
		3	-0.60	0.18	0.14	-1.46	0.26
		4	-1.49*	0.22	0.00	-2.53	-0.45
		5	-1.93*	0.27	0.00	-3.31	-0.56
		6	-2.38*	0.33	0.00	-4.14	-0.63
		7	-3.23*	0.26	0.00	-4.50	-1.98
	2	3	-0.13	0.17	1.00	-0.91	0.66
		4	-1.01*	0.21	0.01	-2.03	-0.01
		5	-1.45*	0.26	0.01	-2.84	-0.08
		6	-1.91*	0.32	0.01	-3.69	-0.13
		7	-2.75*	0.25	0.00	-4.01	-1.51
	3	4	-0.89	0.21	0.03	-1.90	0.12
		5	-1.33*	0.27	0.01	-2.71	0.05
		6	-1.78*	0.32	0.01	-3.56	-0.01
		7	-2.63*	0.25	0.00	-3.89	-1.38
	4	5	-0.44	0.29	0.99	-1.85	0.97
		6	-0.89	0.35	0.51	-2.64	0.85
		7	-1.74*	0.28	0.00	-3.05	-0.44
	5	6	-0.45	0.38	1.00	-2.27	1.37
		7	-1.30	0.32	0.03	-2.80	0.20
	6	7	-0.85	0.37	0.67	-2.63	0.93
SLR	0	1	-0.62	0.27	0.67	-1.90	0.65
		2	-1.26*	0.28	0.01	-2.57	0.05
		3	-1.51*	0.27	0.00	-2.76	-0.26
		4	-1.96*	0.27	0.00	-3.20	-0.72
		5	-2.48*	0.28	0.00	-3.79	-1.18
		6	-3.28*	0.28	0.00	-4.58	-2.00
		7	-3.81*	0.28	0.00	-5.12	-2.50
	1	2	-0.64	0.28	0.68	-1.95	0.68
		3	-0.89	0.27	0.14	-2.14	0.37
		4	-1.33*	0.27	0.01	-2.58	-0.09

		3	-0.44	0.16	0.41	-1.28	0.39
		4	-0.99*	0.11	0.00	-1.50	-0.49
		5	-1.66*	0.18	0.00	-2.63	-0.70
		6	-2.39*	0.34	0.00	-4.48	-0.31
		7	-2.88*	0.35	0.00	-5.06	-0.70
	1	2	-0.34	0.39	1.00	-2.16	1.48
		3	-1.59*	0.29	0.01	-3.10	-0.10
		4	-2.14*	0.27	0.00	-3.70	-0.60
		5	-2.81*	0.31	0.00	-4.32	-1.31
		6	-3.54*	0.42	0.00	-5.56	-1.54
		7	-4.03*	0.43	0.00	-6.12	-1.96
	2	3	-1.26	0.32	0.08	-2.95	0.44
		4	-1.80*	0.30	0.01	-3.58	-0.04
		5	-2.47*	0.33	0.00	-4.17	-0.78
		6	-3.20*	0.44	0.00	-5.29	-1.13
		7	-3.69*	0.45	0.00	-5.84	-1.56
	3	4	-0.55	0.17	0.17	-1.38	0.28
		5	-1.22*	0.22	0.00	-2.24	-0.20
		6	-1.95*	0.36	0.01	-3.91	0.01
		7	-2.44*	0.38	0.00	-4.50	-0.38
	4	5	-0.67	0.18	0.11	-1.62	0.28
		6	-1.40	0.34	0.10	-3.45	0.65
		7	-1.89	0.36	0.02	-4.04	0.26
	5	6	-0.73	0.37	0.89	-2.68	1.21
		7	-1.22	0.38	0.25	-3.26	0.82
	6	7	-0.49	0.48	1.00	-2.74	1.77
MSLR	0	1	0.47	0.46	1.00	-1.70	2.63
		2	-0.42	0.39	1.00	-2.35	1.51
		3	-0.85	0.39	0.77	-2.79	1.08
		4	-1.38	0.40	0.12	-3.33	0.57
		5	-1.94*	0.40	0.01	-3.89	0.00
		6	-2.51*	0.40	0.00	-4.45	-0.57
		7	-3.10*	0.42	0.00	-5.12	-1.09
	1	2	-0.89	0.38	0.67	-2.77	1.00
		3	-1.32	0.39	0.14	-3.22	0.58
		4	-1.85*	0.40	0.01	-3.76	0.07

		5	-1.86*	0.28	0.00	-3.17	-0.55			5	-2.41*	0.39	0.00	-4.32	-0.51
		6	-2.66*	0.28	0.00	-3.96	-1.37			6	-2.97*	0.39	0.00	-4.88	-1.07
		7	-3.18*	0.28	0.00	-4.50	-1.88			7	-3.57*	0.42	0.00	-5.55	-1.59
	2	3	-0.25	0.28	1.00	-1.54	1.05		2	3	-0.43	0.29	0.99	-1.79	0.93
		4	-0.70	0.27	0.49	-1.98	0.59			4	-0.96	0.30	0.17	-2.38	0.46
		5	-1.22	0.29	0.02	-2.56	0.12			5	-1.52*	0.30	0.00	-2.92	-0.13
		6	-2.02*	0.28	0.00	-3.35	-0.70			6	-2.08*	0.29	0.00	-3.47	-0.71
		7	-2.55*	0.29	0.00	-3.90	-1.20			7	-2.68*	0.33	0.00	-4.27	-1.10
	3	4	-0.45	0.26	0.96	-1.67	0.77		3	4	-0.53	0.31	0.96	-1.98	0.92
		5	-0.98	0.27	0.09	-2.26	0.31			5	-1.10	0.31	0.08	-2.53	0.34
		6	-1.78*	0.27	0.00	-3.05	-0.51			6	-1.65*	0.30	0.00	-3.08	-0.24
		7	-2.30*	0.28	0.00	-3.59	-1.01			7	-2.25*	0.34	0.00	-3.86	-0.64
	4	5	-0.53	0.27	0.88	-1.80	0.75		4	5	-0.57	0.32	0.94	-2.05	0.92
		6	-1.32*	0.27	0.01	-2.59	-0.07			6	-1.13	0.31	0.08	-2.60	0.34
		7	-1.85*	0.27	0.00	-3.14	-0.57			7	-1.72*	0.35	0.01	-3.37	-0.08
	5	6	-0.80	0.28	0.31	-2.12	0.52		5	6	-0.56	0.31	0.93	-2.02	0.89
		7	-1.33*	0.29	0.01	-2.67	0.01			7	-1.16	0.35	0.13	-2.79	0.47
	6	7	-0.52	0.28	0.92	-1.85	0.80		6	7	-0.59	0.34	0.96	-2.22	1.03

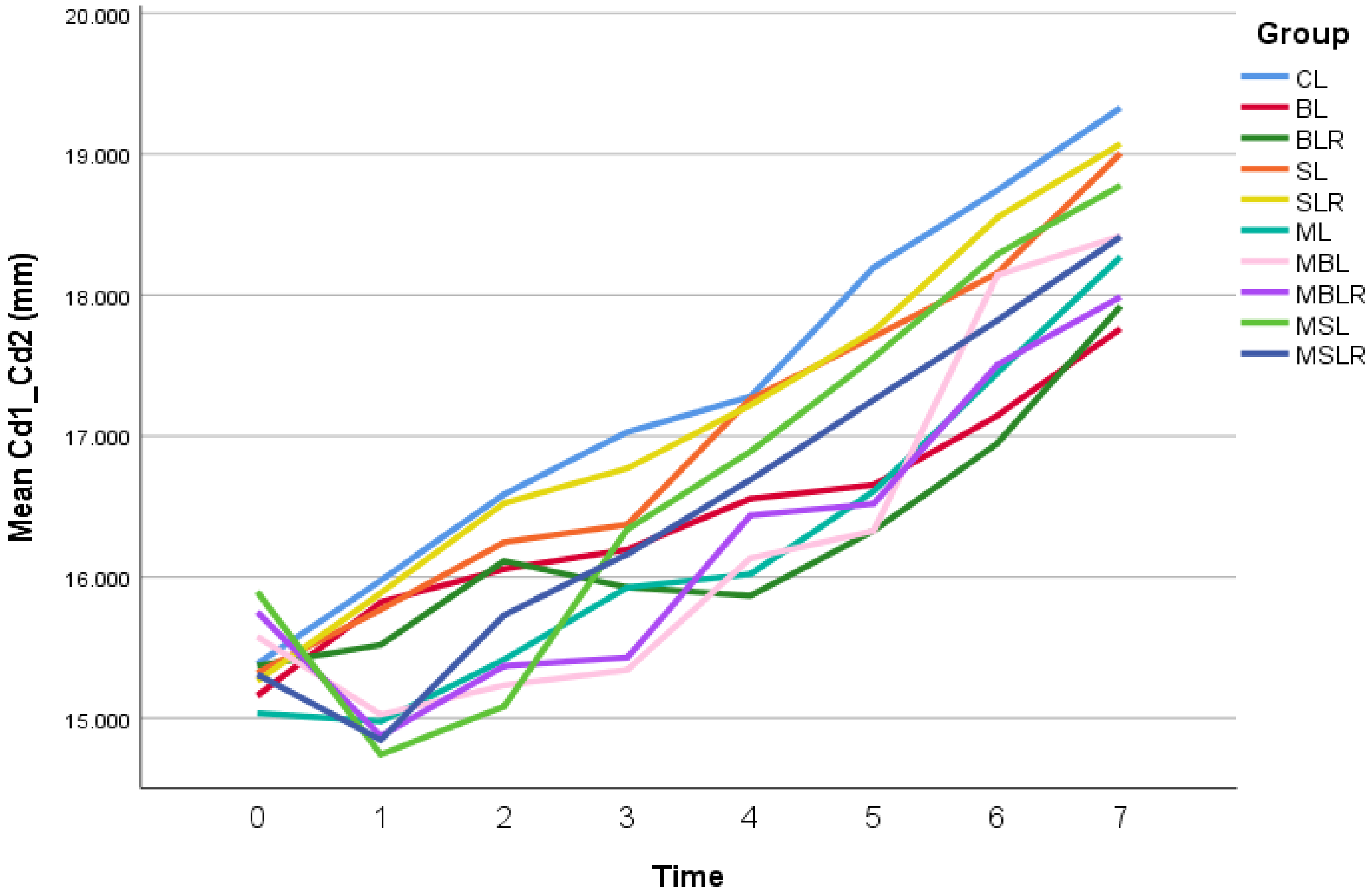


Figure 78: Line graph of mean lengths of Cd1↔Cd2 (mm) for DVC-LT groups at timepoints T0 to T7

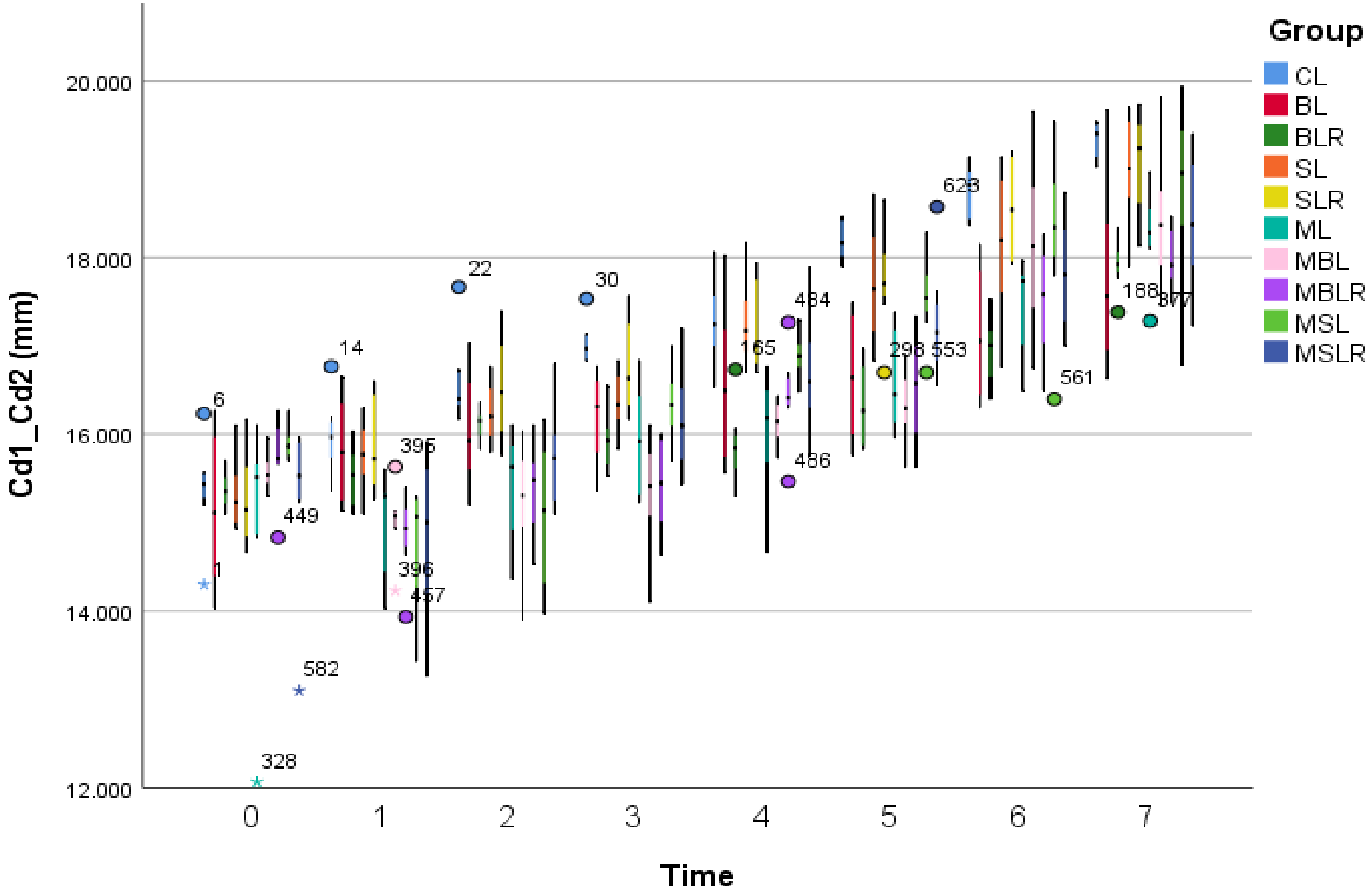


Figure 79: Boxplot of Cd1↔Cd2 (mm) for DVC-LT groups at timepoints T0 to T7

5.3.2.5 Posterior DVC-LT Zygomatic Widths (Zp1 to Zp2)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Zp1↔Zp2 are displayed below (Table XLV). A line graph of the group means and a boxplot of Zp1↔Zp2 are displayed below in Figures 80 and 81. At T4 The BLR group had a significantly narrower posterior zygomatic width (Zp1↔ Zp2) than the CL, SL and SLR groups ($p \leq 0.01$). The MBL group had a significantly narrower posterior zygomatic width than the SL group ($p \leq 0.01$). At T5 The BLR and MBL groups had significantly narrower posterior zygomatic widths (Zp1↔ Zp2) than the CL and MSL groups ($p \leq 0.001$). At T6 The BLR group had a significantly narrower posterior zygomatic widths (Zp1↔ Zp2) than the CL and MBL groups ($p \leq 0.01$). At T7 The BLR group had a significantly narrower posterior zygomatic widths (Zp1↔ Zp2) than the CL, SLR, ML, MBL, and MBLR groups ($p \leq 0.01$). The BLR group finished with the lowest posterior zygomatic width.

Table XLV: Multiple Comparisons Within Groups for Zp1 to Zp2

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval		Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$						Lower	Upper							Lower	Upper
CL	0	1	-0.73	0.27	0.38	-2	0.53	ML	0	1	-0.56	0.38	0.99	-2.34	1.22
		2	-1.56*	0.31	0.01	-3.07	-0.06			2	-0.67	0.33	0.83	-2.29	0.94
		3	-2.07*	0.28	0.00	-3.41	-0.74			3	-1.01	0.34	0.27	-2.64	0.63
		4	-2.52*	0.28	0.00	-3.82	-1.23			4	-1.21	0.40	0.22	-3.08	0.66
		5	-3.40*	0.25	0.00	-4.55	-2.25			5	-2.22*	0.38	0.00	-3.98	-0.46
		6	-4.14*	0.28	0.00	-5.47	-2.83			6	-3.37*	0.38	0.00	-5.16	-1.59
		7	-4.62*	0.24	0.00	-5.77	-3.48			7	-4.26*	0.32	0.00	-5.88	-2.65
	1	2	-0.83	0.32	0.48	-2.36	0.70		1	2	-0.11	0.31	1.00	-1.64	1.42
		3	-1.34*	0.29	0.01	-2.72	0.04			3	-0.44	0.33	1.00	-2.00	1.12
		4	-1.79*	0.29	0.00	-3.13	-0.45			4	-0.65	0.39	0.97	-2.48	1.17
		5	-2.66*	0.26	0.00	-3.89	-1.45			5	-1.66*	0.36	0.01	-3.36	0.04
		6	-3.41*	0.29	0.00	-4.78	-2.05			6	-2.81*	0.37	0.00	-4.55	-1.08
		7	-3.88*	0.26	0.00	-5.10	-2.68			7	-3.70*	0.31	0.00	-5.23	-2.17
	2	3	-0.51	0.33	0.99	-2.08	1.06		2	3	-0.33	0.26	1.00	-1.56	0.89
		4	-0.96	0.33	0.27	-2.51	0.59			4	-0.54	0.34	0.98	-2.22	1.14
		5	-1.83*	0.30	0.00	-3.32	-0.35			5	-1.54*	0.31	0.01	-3.04	-0.06
		6	-2.58*	0.33	0.00	-4.15	-1.03			6	-2.70*	0.32	0.00	-4.25	-1.16
		7	-3.05*	0.30	0.00	-4.54	-1.58			7	-3.59*	0.24	0.00	-4.73	-2.45

	3	4	-0.45	0.30	0.99	-1.85	0.95
		5	-1.32*	0.27	0.01	-2.62	-0.03
		6	-2.07*	0.30	0.00	-3.49	-0.66
		7	-2.54*	0.27	0.00	-3.84	-1.25
	4	5	-0.88	0.26	0.14	-2.13	0.38
		6	-1.62*	0.30	0.00	-3.01	-0.24
		7	-2.09*	0.26	0.00	-3.34	-0.85
	5	6	-0.75	0.27	0.35	-2.03	0.53
		7	-1.22*	0.23	0.00	-2.30	-0.15
	6	7	-0.47	0.27	0.95	-1.74	0.80
BL	0	1	-0.74	0.55	1.00	-3.39	1.91
		2	-1.21	0.52	0.67	-3.80	1.37
		3	-1.52	0.51	0.29	-4.09	1.05
		4	-2.13	0.53	0.05	-4.72	0.46
		5	-2.22	0.52	0.03	-4.8	0.35
		6	-3.02*	0.58	0.00	-5.75	-0.30
		7	-4.07*	0.54	0.00	-6.68	-1.47
	1	2	-0.48	0.44	1.00	-2.54	1.59
		3	-0.79	0.42	0.91	-2.79	1.22
		4	-1.39	0.44	0.19	-3.47	0.69
		5	-1.49	0.43	0.11	-3.52	0.55
		6	-2.29*	0.50	0.01	-4.63	0.06
		7	-3.33*	0.45	0.00	-5.46	-1.22
	2	3	-0.31	0.38	1.00	-2.08	1.47
		4	-0.92	0.40	0.68	-2.81	0.97
		5	-1.01	0.39	0.45	-2.83	0.81
		6	-1.81	0.47	0.05	-4.04	0.42
		7	-2.86*	0.42	0.00	-4.81	-0.92
	3	4	-0.61	0.38	0.98	-2.41	1.20
		5	-0.70	0.37	0.90	-2.43	1.03
		6	-1.50	0.45	0.15	-3.69	0.69
		7	-2.55*	0.40	0.00	-4.42	-0.68
	4	5	-0.09	0.40	1.00	-1.94	1.76
		6	-0.89	0.47	0.90	-3.13	1.35
		7	-1.94*	0.42	0.01	-3.91	0.02
	5	6	-0.80	0.46	0.96	-3.01	1.41

	3	4	-0.21	0.35	1.00	-1.91	1.49
		5	-1.22	0.32	0.06	-2.74	0.31
		6	-2.37*	0.33	0.00	-3.94	-0.8
		7	-3.25*	0.26	0.00	-4.47	-2.04
	4	5	-1.01	0.38	0.44	-2.81	0.8
		6	-2.16*	0.39	0.00	-4	-0.33
		7	-3.05*	0.34	0.00	-4.73	-1.37
	5	6	-1.16	0.37	0.18	-2.87	0.55
		7	-2.04*	0.31	0.00	-3.53	-0.55
	6	7	-0.89	0.31	0.35	-2.42	0.65
MBL	0	1	-0.21	0.19	1.00	-1.12	0.69
		2	-0.66	0.18	0.06	-1.49	0.17
		3	-0.66	0.17	0.05	-1.48	0.15
		4	-0.91*	0.17	0.00	-1.72	-0.11
		5	-1.48*	0.18	0.00	-2.34	-0.62
		6	-3.62*	0.25	0.00	-4.89	-2.37
		7	-4.13*	0.23	0.00	-5.27	-3
	1	2	-0.45	0.18	0.55	-1.3	0.41
		3	-0.45	0.18	0.49	-1.29	0.39
		4	-0.70	0.17	0.04	-1.53	0.13
		5	-1.26*	0.19	0.00	-2.14	-0.39
		6	-3.41*	0.26	0.00	-4.68	-2.15
		7	-3.91*	0.24	0.00	-5.06	-2.78
	2	3	0.00	0.16	1.00	-0.74	0.73
		4	-0.25	0.15	0.97	-0.97	0.47
		5	-0.82*	0.17	0.01	-1.62	-0.02
		6	-2.96*	0.24	0.00	-4.22	-1.71
		7	-3.47*	0.22	0.00	-4.59	-2.36
	3	4	-0.25	0.15	0.97	-0.94	0.44
		5	-0.81*	0.16	0.01	-1.59	-0.04
		6	-2.96*	0.24	0.00	-4.22	-1.71
		7	-3.46*	0.22	0.00	-4.58	-2.35
	4	5	-0.57	0.16	0.10	-1.33	0.19
		6	-2.71*	0.24	0.00	-3.98	-1.46
		7	-3.22*	0.22	0.00	-4.34	-2.11
	5	6	-2.14*	0.25	0.00	-3.4	-0.89

		7	-1.85*	0.41	0.01	-3.76	0.06			7	-2.65*	0.23	0.00	-3.78	-1.53
	6	7	-1.05	0.48	0.74	-3.32	1.22		6	7	-0.51	0.29	0.95	-1.86	0.85
BLR	0	1	-0.35	0.14	0.51	-1.02	0.32	MBLR	0	1	-0.21	0.29	1.00	-1.56	1.14
		2	-0.96*	0.16	0.00	-1.72	-0.21			2	-0.57	0.32	0.94	-2.06	0.92
		3	-1.08	0.23	0.02	-2.22	0.07			3	-0.80	0.25	0.20	-2.04	0.43
		4	-1.26*	0.19	0.00	-2.17	-0.35			4	-1.04	0.32	0.15	-2.54	0.46
		5	-1.72*	0.19	0.00	-2.64	-0.81			5	-1.76*	0.29	0.00	-3.13	-0.39
		6	-2.71*	0.15	0.00	-3.43	-2.00			6	-2.33*	0.29	0.00	-3.68	-1.00
		7	-3.17*	0.17	0.00	-3.97	-2.39			7	-3.34*	0.26	0.00	-4.60	-2.08
	1	2	-0.61	0.14	0.02	-1.28	0.05		1	2	-0.36	0.31	1.00	-1.82	1.10
		3	-0.72	0.21	0.19	-1.89	0.44			3	-0.60	0.24	0.57	-1.77	0.58
		4	-0.90*	0.17	0.01	-1.79	-0.03			4	-0.83	0.31	0.41	-2.30	0.64
		5	-1.37*	0.17	0.00	-2.26	-0.48			5	-1.55*	0.28	0.00	-2.88	-0.22
		6	-2.36*	0.13	0.00	-2.96	-1.76			6	-2.12*	0.28	0.00	-3.42	-0.84
		7	-2.82*	0.15	0.00	-3.55	-2.10			7	-3.13*	0.25	0.00	-4.33	-1.94
	2	3	-0.11	0.23	1.00	-1.25	1.04		2	3	-0.24	0.28	1.00	-1.62	1.15
		4	-0.30	0.19	0.99	-1.20	0.61			4	-0.47	0.34	1.00	-2.05	1.11
		5	-0.76	0.19	0.04	-1.67	0.15			5	-1.19	0.31	0.06	-2.67	0.28
		6	-1.74*	0.15	0.00	-2.46	-1.04			6	-1.76*	0.31	0.00	-3.22	-0.32
		7	-2.21*	0.17	0.00	-3.00	-1.42			7	-2.77*	0.29	0.00	-4.17	-1.38
	3	4	-0.19	0.25	1.00	-1.37	1.00		3	4	-0.24	0.28	1.00	-1.63	1.16
		5	-0.65	0.25	0.46	-1.84	0.54			5	-0.96	0.25	0.06	-2.17	0.25
		6	-1.63*	0.22	0.00	-2.79	-0.49			6	-1.53*	0.24	0.00	-2.69	-0.38
		7	-2.10*	0.23	0.00	-3.25	-0.95			7	-2.53*	0.21	0.00	-3.54	-1.54
	4	5	-0.46	0.22	0.76	-1.47	0.54		4	5	-0.72	0.32	0.67	-2.21	0.76
		6	-1.45*	0.18	0.00	-2.34	-0.56			6	-1.30	0.31	0.03	-2.76	0.16
		7	-1.91*	0.20	0.00	-2.84	-0.99			7	-2.30*	0.29	0.00	-3.71	-0.90
	5	6	-0.99*	0.18	0.00	-1.89	-0.10		5	6	-0.58	0.28	0.83	-1.90	0.74
		7	-1.45*	0.20	0.00	-2.39	-0.52			7	-1.58*	0.26	0.00	-2.81	-0.35
	6	7	-0.46	0.16	0.28	-1.22	0.29		6	7	-1.00	0.25	0.04	-2.19	0.18
SL	0	1	-1.02	0.35	0.26	-2.66	0.61	MSL	0	1	-0.07	0.26	1.00	-1.28	1.14
		2	-1.95*	0.32	0.00	-3.46	-0.44			2	-0.52	0.27	0.89	-1.81	0.76
		3	-2.18*	0.31	0.00	-3.68	-0.70			3	-0.63	0.30	0.82	-2.09	0.83
		4	-2.98*	0.30	0.00	-4.46	-1.50			4	-1.39*	0.25	0.00	-2.55	-0.24
		5	-3.45*	0.34	0.00	-5.07	-1.84			5	-2.41*	0.24	0.00	-3.56	-1.27
		6	-4.02*	0.39	0.00	-5.87	-2.18			6	-3.48*	0.38	0.00	-5.48	-1.50

		7	-4.70*	0.37	0.00	-6.42	-3.00
	1	2	-0.93	0.31	0.24	-2.38	0.53
		3	-1.16	0.30	0.05	-2.6	0.28
		4	-1.95*	0.29	0.00	-3.38	-0.53
		5	-2.42*	0.34	0.00	-4.00	-0.85
		6	-3.00*	0.38	0.00	-4.82	-1.18
		7	-3.68*	0.36	0.00	-5.37	-2.00
	2	3	-0.24	0.26	1.00	-1.46	0.99
		4	-1.03	0.25	0.03	-2.23	0.16
		5	-1.50*	0.30	0.01	-2.94	-0.07
		6	-2.07*	0.35	0.00	-3.82	-0.33
		7	-2.75*	0.33	0.00	-4.33	-1.18
	3	4	-0.80	0.25	0.15	-1.94	0.35
		5	-1.27	0.30	0.02	-2.68	0.14
		6	-1.83*	0.35	0.01	-3.58	-0.10
		7	-2.52*	0.32	0.00	-4.08	-0.96
	4	5	-0.47	0.29	0.98	-1.86	0.92
		6	-1.04	0.34	0.27	-2.78	0.69
		7	-1.72*	0.31	0.00	-3.28	-0.17
	5	6	-0.57	0.38	0.99	-2.38	1.23
		7	-1.25	0.35	0.09	-2.92	0.41
	6	7	-0.68	0.40	0.96	-2.56	1.19
SLR	0	1	-1.17	0.44	0.40	-3.21	0.87
		2	-1.98*	0.40	0.01	-3.86	-0.12
		3	-2.35*	0.36	0.00	-4.15	-0.57
		4	-2.96*	0.37	0.00	-4.77	-1.17
		5	-3.60*	0.42	0.00	-5.56	-1.65
		6	-4.59*	0.40	0.00	-6.48	-2.71
		7	-5.14*	0.39	0.00	-7.01	-3.28
	1	2	-0.82	0.40	0.82	-2.70	1.06
		3	-1.19	0.36	0.17	-2.99	0.62
		4	-1.80*	0.37	0.01	-3.62	0.02
		5	-2.43*	0.42	0.00	-4.40	-0.47
		6	-3.42*	0.40	0.00	-5.32	-1.53
		7	-3.97*	0.40	0.00	-5.85	-2.10
	2	3	-0.37	0.31	1.00	-1.84	1.11

		7	-4.12*	0.34	0.00	-5.85	-2.39
	1	2	-0.46	0.29	0.98	-1.79	0.88
		3	-0.56	0.31	0.94	-2.06	0.94
		4	-1.32*	0.26	0.01	-2.56	-0.10
		5	-2.34*	0.26	0.00	-3.57	-1.13
		6	-3.41*	0.39	0.00	-5.40	-1.43
		7	-4.05*	0.36	0.00	-5.80	-2.31
	2	3	-0.10	0.33	1.00	-1.64	1.43
		4	-0.87	0.28	0.18	-2.17	0.43
		5	-1.89*	0.27	0.00	-3.19	-0.60
		6	-2.96*	0.40	0.00	-4.96	-0.97
		7	-3.59*	0.36	0.00	-5.36	-1.84
	3	4	-0.77	0.31	0.52	-2.24	0.70
		5	-1.78*	0.30	0.00	-3.25	-0.32
		6	-2.85*	0.42	0.00	-4.89	-0.83
		7	-3.49*	0.39	0.00	-5.32	-1.67
	4	5	-1.02	0.25	0.03	-2.18	0.15
		6	-2.09*	0.38	0.01	-4.08	-0.10
		7	-2.72*	0.35	0.00	-4.46	-0.99
	5	6	-1.07	0.38	0.40	-3.06	0.92
		7	-1.71*	0.35	0.01	-3.44	0.03
	6	7	-0.63	0.45	1.00	-2.76	1.49
MSLR	0	1	-0.20	0.17	1.00	-1.04	0.65
		2	-0.45	0.20	0.73	-1.47	0.57
		3	-0.95	0.25	0.11	-2.33	0.42
		4	-1.50	0.30	0.03	-3.22	0.22
		5	-2.23*	0.28	0.00	-3.79	-0.68
		6	-3.01*	0.28	0.00	-4.58	-1.45
		7	-3.80*	0.19	0.00	-4.75	-2.86
	1	2	-0.26	0.23	1.00	-1.33	0.81
		3	-0.76	0.27	0.39	-2.12	0.60
		4	-1.30	0.32	0.06	-2.98	0.37
		5	-2.04*	0.30	0.00	-3.56	-0.52
		6	-2.82*	0.30	0.00	-4.35	-1.29
		7	-3.60*	0.22	0.00	-4.63	-2.59
	2	3	-0.50	0.29	0.96	-1.90	0.89

		4	-0.98	0.32	0.22	-2.49	0.53			4	-1.05	0.34	0.23	-2.72	0.63
		5	-1.61	0.38	0.02	-3.38	0.15			5	-1.78*	0.31	0.00	-3.32	-0.25
		6	-2.60*	0.36	0.00	-4.27	-0.94			6	-2.56*	0.32	0.00	-4.11	-1.02
		7	-3.15*	0.35	0.00	-4.78	-1.52			7	-3.35*	0.24	0.00	-4.47	-2.23
	3	4	-0.61	0.27	0.69	-1.89	0.66		3	4	-0.54	0.37	0.99	-2.30	1.21
		5	-1.25	0.34	0.08	-2.90	0.41			5	-1.28	0.35	0.07	-2.92	0.36
		6	-2.23*	0.31	0.00	-3.75	-0.73			6	-2.06*	0.35	0.00	-3.71	-0.41
		7	-2.78*	0.31	0.00	-4.25	-1.32			7	-2.85*	0.28	0.00	-4.23	-1.47
	4	5	-0.63	0.35	0.93	-2.31	1.04		4	5	-0.74	0.39	0.90	-2.56	1.08
		6	-1.62*	0.33	0.01	-3.17	-0.08			6	-1.52	0.39	0.04	-3.34	0.30
		7	-2.17*	0.32	0.00	-3.68	-0.67			7	-2.30*	0.33	0.00	-3.98	-0.64
	5	6	-0.99	0.38	0.45	-2.77	0.80		5	6	-0.78	0.37	0.78	-2.52	0.95
		7	-1.54	0.37	0.03	-3.30	0.22			7	-1.56*	0.31	0.01	-3.09	-0.04
	6	7	-0.55	0.35	0.99	-2.21	1.10		6	7	-0.79	0.31	0.53	-2.32	0.75

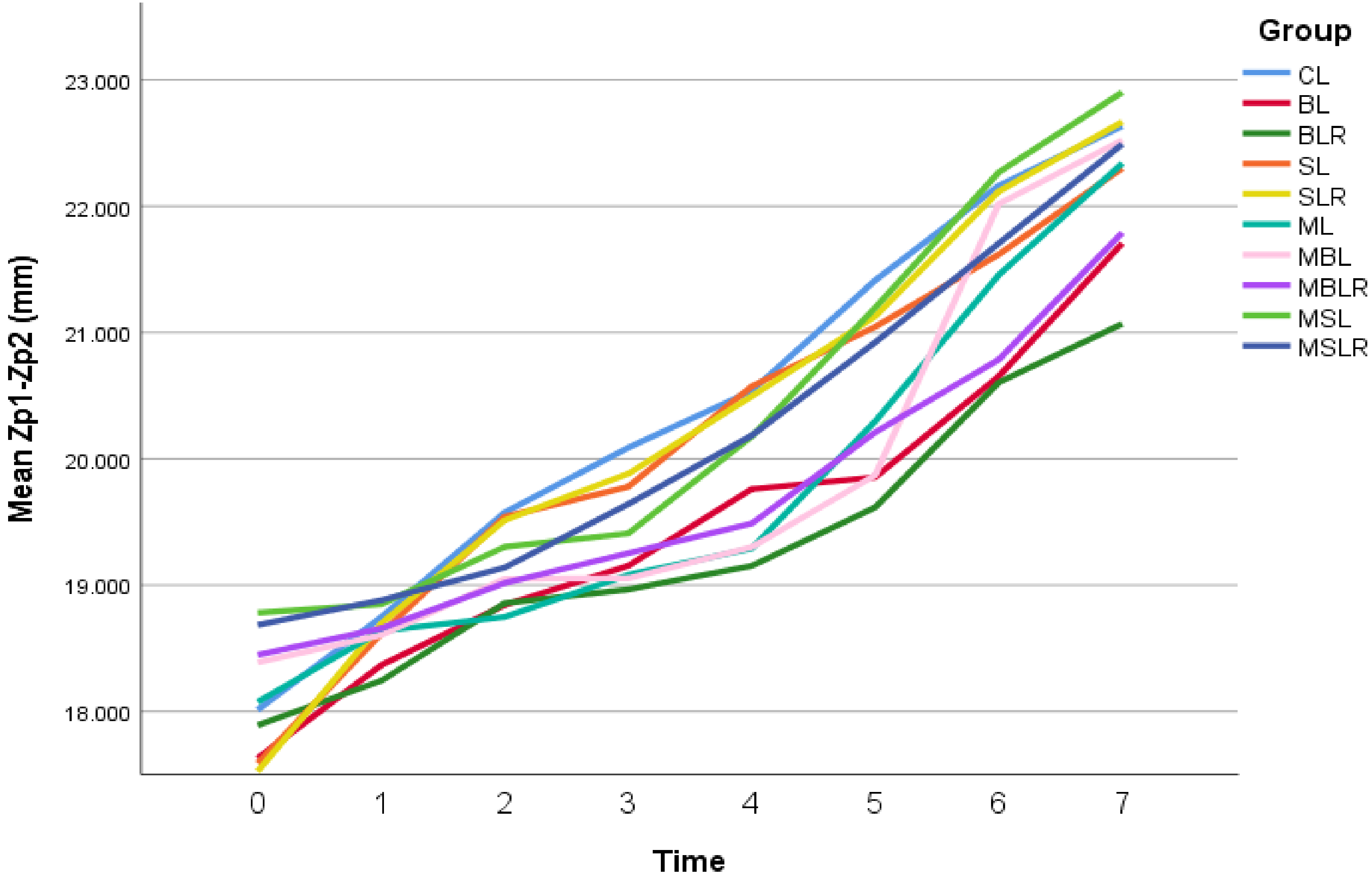


Figure 80: Line graph of mean lengths of Zp1↔Zp2 (mm) for DVC-LT groups at timepoints T0 to T7

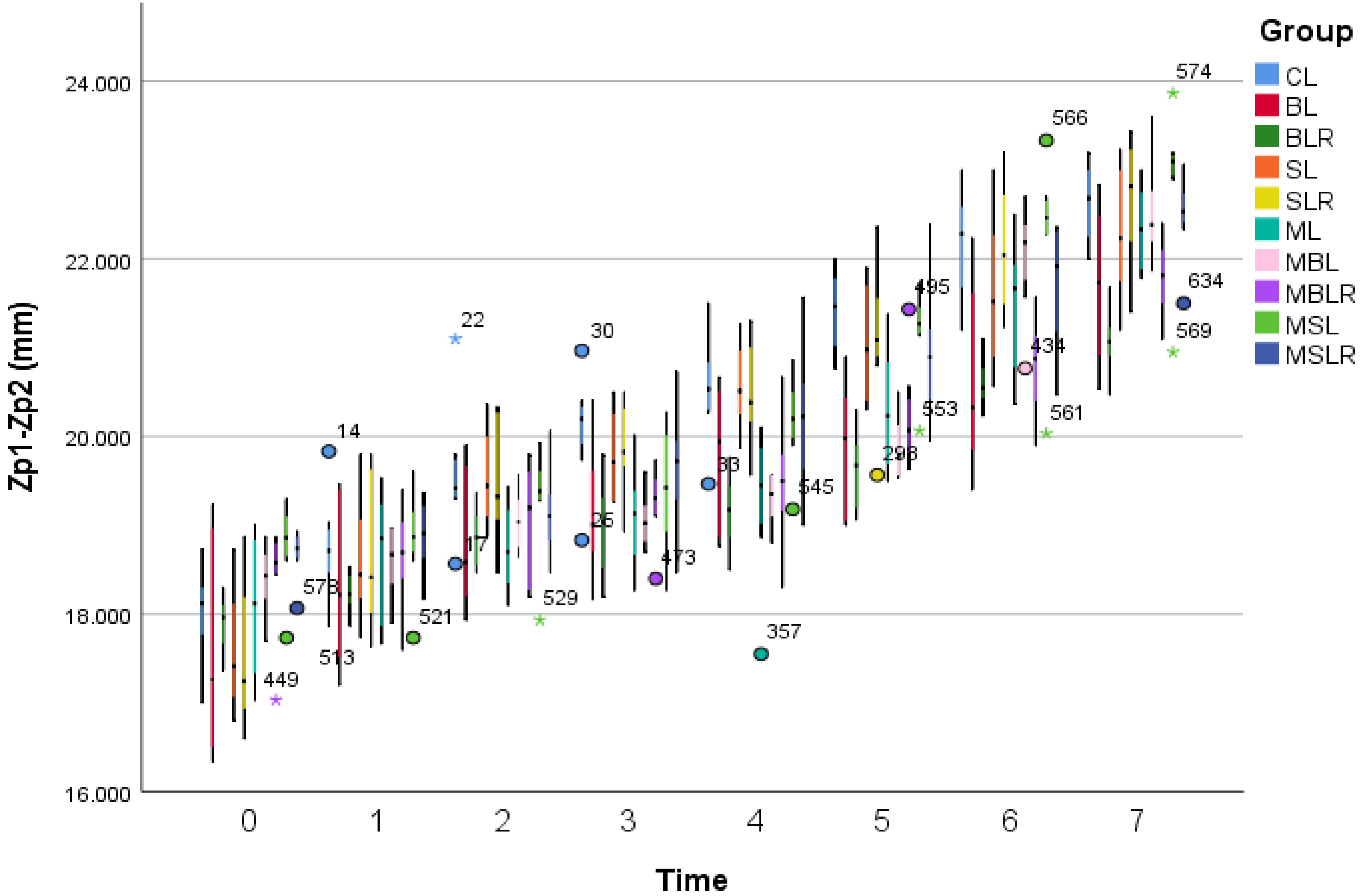


Figure 81: Boxplot of Zp1↔Zp2 (mm) for DVC-LT groups at timepoints T0 to T7

5.3.2.6 Anterior DVC-LT Zygomatic Widths (xZa1 to xZa2)

Multiple comparisons within the groups between T0, T1, T2, T3, T4, T5, T6, and T7 for Za1↔Za2 are displayed below (Table XLVI). A line graph of the group means and a boxplot of Za1↔Za2 are displayed below in Figures 82 and 83. At T4 The BLR group had significantly narrower anterior zygomatic widths (Za1↔Za2) than the SL and MSL groups ($p \leq 0.01$). At T5 The BLR group had a significantly narrower anterior zygomatic widths than the MSL groups ($p \leq 0.01$). At T6 The BLR group had a significantly narrower anterior zygomatic widths than MBL and MSLR groups ($p \leq 0.001$). At T7 The BLR group had a significantly narrower anterior zygomatic widths than the SLR, MBL, and MSLR groups ($p \leq 0.001$). From T3 to T7 the BLR group had the lowest anterior zygomatic widths.

Table XLVI: Multiple Comparisons Within Groups Za1 to Za2

* The mean difference is significant at the $p \leq 0.01$ or $p \leq 0.001$

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval Lower	99% Confidence Interval Upper
CL	0	1	-0.26	0.15	0.95	-0.95	0.43
		2	-0.68	0.15	0.02	-1.41	0.05
		3	-0.87*	0.15	0.00	-1.60	-0.14
		4	-0.95*	0.18	0.00	-1.83	-0.09
		5	-1.51*	0.12	0.00	-2.09	-0.93
		6	-1.81*	0.14	0.00	-2.47	-1.15
		7	-2.09*	0.18	0.00	-2.97	-1.21
	1	2	-0.42	0.16	0.43	-1.17	0.33
		3	-0.61	0.16	0.05	-1.37	0.14
		4	-0.70	0.18	0.06	-1.58	0.18
		5	-1.25*	0.13	0.00	-1.89	-0.62
		6	-1.55*	0.15	0.00	-2.25	-0.86
		7	-1.83*	0.19	0.00	-2.73	-0.94
	2	3	-0.19	0.17	1.00	-0.97	0.59
		4	-0.28	0.19	0.99	-1.18	0.62
		5	-0.83*	0.14	0.00	-1.52	-0.15
		6	-1.13*	0.16	0.00	-1.86	-0.40
		7	-1.41*	0.19	0.00	-2.32	-0.50
	3	4	-0.09	0.19	1.00	-0.99	0.81
		5	-0.64	0.14	0.02	-1.33	0.05

Group	Time (I)	Time (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval Lower	99% Confidence Interval Upper
ML	0	1	-0.24	0.15	0.98	-0.93	0.46
		2	-0.40	0.12	0.14	-0.97	0.17
		3	-0.70*	0.13	0.00	-1.30	-0.10
		4	-0.85*	0.17	0.01	-1.69	-0.02
		5	-1.24*	0.17	0.00	-2.08	-0.41
		6	-1.82*	0.15	0.00	-2.56	-1.10
		7	-2.09*	0.16	0.00	-2.84	-1.35
	1	2	-0.16	0.13	1.00	-0.81	0.49
		3	-0.46	0.14	0.15	-1.13	0.21
		4	-0.62	0.18	0.12	-1.47	0.24
		5	-1.00*	0.18	0.00	-1.86	-0.14
		6	-1.59*	0.16	0.00	-2.36	-0.82
		7	-1.86*	0.17	0.00	-2.64	-1.08
	2	3	-0.30	0.11	0.36	-0.82	0.22
		4	-0.46	0.16	0.36	-1.28	0.37
		5	-0.84*	0.16	0.01	-1.67	-0.01
		6	-1.43*	0.14	0.00	-2.13	-0.73
		7	-1.70*	0.14	0.00	-2.42	-0.98
	3	4	-0.16	0.16	1.00	-0.98	0.67
		5	-0.54	0.17	0.18	-1.37	0.29

		6	-0.93*	0.16	0.00	-1.67	-0.21
		7	-1.22*	0.19	0.00	-2.13	-0.31
	4	5	-0.55	0.16	0.18	-1.42	0.31
		6	-0.85*	0.18	0.01	-1.72	0.02
		7	-1.13*	0.21	0.00	-2.12	-0.15
	5	6	-0.30	0.12	0.58	-0.89	0.30
		7	-0.58	0.17	0.15	-1.46	0.30
	6	7	-0.28	0.18	0.99	-1.17	0.60
BL	0	1	-0.26	0.23	1.00	-1.39	0.88
		2	-0.55	0.24	0.67	-1.71	0.61
		3	-0.72	0.23	0.22	-1.86	0.42
		4	-1.05	0.25	0.03	-2.23	0.13
		5	-1.27*	0.24	0.01	-2.44	-0.10
		6	-1.62*	0.22	0.00	-2.76	-0.49
		7	-1.98*	0.22	0.00	-3.11	-0.85
	1	2	-0.30	0.18	0.98	-1.16	0.57
		3	-0.47	0.17	0.36	-1.26	0.33
		4	-0.79	0.19	0.04	-1.72	0.14
		5	-1.01*	0.19	0.00	-1.91	-0.12
		6	-1.36*	0.15	0.00	-2.09	-0.65
		7	-1.72*	0.16	0.00	-2.47	-0.98
	2	3	-0.17	0.19	1.00	-1.06	0.71
		4	-0.50	0.21	0.61	-1.48	0.49
		5	-0.72	0.20	0.09	-1.67	0.24
		6	-1.07*	0.17	0.00	-1.91	-0.24
		7	-1.42*	0.18	0.00	-2.28	-0.58
	3	4	-0.33	0.20	0.98	-1.27	0.62
		5	-0.55	0.19	0.32	-1.46	0.37
		6	-0.90*	0.16	0.00	-1.66	-0.14
		7	-1.25*	0.17	0.00	-2.04	-0.48
	4	5	-0.22	0.22	1.00	-1.23	0.79
		6	-0.58	0.19	0.23	-1.49	0.34
		7	-0.93*	0.19	0.01	-1.85	-0.01
	5	6	-0.36	0.18	0.87	-1.23	0.52
		7	-0.71	0.18	0.05	-1.59	0.17
	6	7	-0.35	0.15	0.59	-1.05	0.34

		6	-1.12*	0.15	0.00	-1.84	-0.42
		7	-1.39*	0.15	0.00	-2.13	-0.67
	4	5	-0.39	0.20	0.89	-1.32	0.55
		6	-0.97*	0.19	0.00	-1.85	-0.10
		7	-1.24*	0.19	0.00	-2.13	-0.36
	5	6	-0.59	0.19	0.19	-1.47	0.29
		7	-0.86*	0.19	0.01	-1.74	0.03
	6	7	-0.27	0.17	0.99	-1.08	0.54
MBL	0	1	-0.38	0.23	0.98	-1.72	0.95
		2	-0.36	0.13	0.35	-0.98	0.26
		3	-0.50	0.13	0.06	-1.14	0.14
		4	-0.84*	0.13	0.00	-1.46	-0.23
		5	-1.14*	0.10	0.00	-1.61	-0.68
		6	-1.84*	0.07	0.00	-2.26	-1.43
		7	-2.14*	0.10	0.00	-2.59	-1.69
	1	2	0.02	0.25	1.00	-1.27	1.31
		3	-0.12	0.25	1.00	-1.41	1.17
		4	-0.46	0.24	0.92	-1.75	0.83
		5	-0.77	0.23	0.25	-2.10	0.56
		6	-1.46*	0.22	0.01	-2.87	-0.06
		7	-1.76*	0.23	0.00	-3.10	-0.42
	2	3	-0.14	0.15	1.00	-0.85	0.57
		4	-0.48	0.15	0.15	-1.18	0.21
		5	-0.78*	0.13	0.00	-1.41	-0.16
		6	-1.48*	0.11	0.00	-2.15	-0.82
		7	-1.78*	0.13	0.00	-2.41	-1.16
	3	4	-0.35	0.15	0.66	-1.05	0.36
		5	-0.64*	0.13	0.01	-1.29	-0.01
		6	-1.34*	0.11	0.00	-2.02	-0.67
		7	-1.64*	0.13	0.00	-2.28	-1.01
	4	5	-0.30	0.13	0.62	-0.92	0.31
		6	-1.00*	0.11	0.00	-1.65	-0.35
		7	-1.30*	0.12	0.00	-1.91	-0.69
	5	6	-0.69*	0.08	0.00	-1.13	-0.27
		7	-0.99*	0.10	0.00	-1.46	-0.54
	6	7	-0.30	0.07	0.06	-0.70	0.10

BLR	0	1	-0.11	0.11	1.00	-0.62	0.40	MBLR	0	1	-0.07	0.09	1.00	-0.51	0.37
		2	-0.49	0.11	0.02	-1.03	0.04			2	-0.51	0.15	0.16	-1.30	0.27
		3	-0.52*	0.11	0.01	-1.05	0.00			3	-0.67*	0.12	0.00	-1.25	-0.09
		4	-0.70*	0.11	0.00	-1.22	-0.18			4	-1.10*	0.10	0.00	-1.59	-0.63
		5	-1.06*	0.12	0.00	-1.61	-0.51			5	-1.17*	0.12	0.00	-1.80	-0.56
		6	-1.36*	0.11	0.00	-1.87	-0.85			6	-1.66*	0.14	0.00	-2.40	-0.93
		7	-1.50*	0.12	0.00	-2.08	-0.93			7	-1.96*	0.11	0.00	-2.52	-1.41
	1	2	-0.38	0.10	0.04	-0.83	0.07		1	2	-0.45	0.15	0.32	-1.23	0.33
		3	-0.41*	0.09	0.01	-0.84	0.02			3	-0.60*	0.12	0.01	-1.19	-0.02
		4	-0.59*	0.09	0.00	-1.01	-0.17			4	-1.04*	0.10	0.00	-1.53	-0.56
		5	-0.95*	0.10	0.00	-1.43	-0.48			5	-1.10*	0.13	0.00	-1.73	-0.49
		6	-1.25*	0.09	0.00	-1.65	-0.85			6	-1.60*	0.14	0.00	-2.33	-0.87
		7	-1.39*	0.11	0.00	-1.91	-0.88			7	-1.90*	0.12	0.00	-2.46	-1.34
	2	3	-0.03	0.10	1.00	-0.500	0.44		2	3	-0.16	0.17	1.00	-0.96	0.64
		4	-0.21	0.10	0.78	-0.67	0.25			4	-0.60	0.16	0.07	-1.38	0.19
		5	-0.57*	0.11	0.00	-1.08	-0.06			5	-0.66	0.17	0.05	-1.48	0.15
		6	-0.87*	0.10	0.00	-1.32	-0.42			6	-1.15*	0.18	0.00	-2.02	-0.29
		7	-1.01*	0.11	0.00	-1.55	-0.48			7	-1.45*	0.16	0.00	-2.25	-0.66
	3	4	-0.18	0.10	0.92	-0.62	0.27		3	4	-0.44	0.13	0.11	-1.04	0.16
		5	-0.53*	0.11	0.01	-1.03	-0.04			5	-0.50*	0.15	0.01	-1.19	0.18
		6	-0.83*	0.09	0.00	-1.27	-0.41			6	-0.99*	0.16	0.00	-1.76	-0.23
		7	-0.97*	0.11	0.00	-1.50	-0.45			7	-1.29*	0.14	0.00	-1.94	-0.65
	4	5	-0.36*	0.10	0.01	-0.85	0.13		4	5	-0.07	0.13	1.00	-0.70	0.57
		6	-0.66*	0.09	0.00	-1.08	-0.24			6	-0.56	0.15	0.08	-1.29	0.18
		7	-0.80*	0.11	0.00	-1.32	-0.28			7	-0.85*	0.12	0.00	-1.44	-0.28
	5	6	-0.3	0.10	0.25	-0.78	0.18		5	6	-0.49	0.17	0.26	-1.27	0.29
		7	-0.44	0.12	0.06	-0.99	0.11			7	-0.79*	0.14	0.00	-1.46	-0.12
	6	7	-0.14	0.11	1.00	-0.65	0.37		6	7	-0.30	0.16	0.90	-1.06	0.45
SL	0	1	-0.27	0.16	0.98	-1.05	0.52	MSL	0	1	-0.04	0.14	1.00	-0.80	0.72
		2	-0.79	0.18	0.02	-1.63	0.05			2	-0.50	0.15	0.28	-1.39	0.39
		3	-0.84*	0.17	0.01	-1.65	-0.03			3	-0.52*	0.08	0.00	-0.89	-0.17
		4	-1.22*	0.16	0.00	-2.00	-0.45			4	-0.91*	0.06	0.00	-1.19	-0.65
		5	-1.43*	0.17	0.00	-2.25	-0.61			5	-1.37*	0.06	0.00	-1.65	-1.10
		6	-1.72*	0.24	0.00	-2.89	-0.56			6	-1.66*	0.13	0.00	-2.40	-0.93
		7	-2.26*	0.20	0.00	-3.20	-1.33			7	-1.84*	0.13	0.00	-2.59	-1.10
	1	2	-0.52	0.15	0.12	-1.26	0.21		1	2	-0.46	0.20	0.62	-1.38	0.46

		3	-0.58	0.14	0.04	-1.25	0.10
		4	-0.95*	0.13	0.00	-1.55	-0.36
		5	-1.16*	0.15	0.00	-1.86	-0.47
		6	-1.45*	0.22	0.00	-2.62	-0.30
		7	-2.00*	0.18	0.00	-2.87	-1.13
	2	3	-0.05	0.16	1.00	-0.81	0.71
		4	-0.43	0.15	0.28	-1.15	0.28
		5	-0.64	0.17	0.05	-1.42	0.13
		6	-0.94	0.23	0.05	-2.09	0.22
		7	-1.47*	0.19	0.00	-2.39	-0.57
	3	4	-0.38	0.13	0.32	-1.02	0.26
		5	-0.59	0.15	0.05	-1.32	0.13
		6	-0.88	0.23	0.07	-2.04	0.27
		7	-1.42*	0.18	0.00	-2.31	-0.55
	4	5	-0.21	0.14	0.99	-0.88	0.46
		6	-0.500	0.21	0.71	-1.67	0.67
		7	-1.04*	0.17	0.00	-1.91	-0.18
	5	6	-0.29	0.23	1.00	-1.45	0.86
		7	-0.84	0.19	0.02	-1.73	0.05
	6	7	-0.54	0.25	0.74	-1.73	0.64
SLR	0	1	-0.46	0.15	0.22	-1.18	0.26
		2	-0.61	0.15	0.03	-1.30	0.08
		3	-0.80*	0.13	0.00	-1.40	-0.20
		4	-1.03*	0.14	0.00	-1.68	-0.39
		5	-1.33*	0.16	0.00	-2.08	-0.59
		6	-1.84*	0.15	0.00	-2.54	-1.15
		7	-2.17*	0.11	0.00	-2.73	-1.62
	1	2	-0.14	0.16	1.00	-0.90	0.62
		3	-0.34	0.15	0.66	-1.04	0.36
		4	-0.57	0.16	0.07	-1.30	0.16
		5	-0.87*	0.17	0.01	-1.68	-0.07
		6	-1.38*	0.16	0.00	-2.14	-0.62
		7	-1.71*	0.13	0.00	-2.40	-1.02
	2	3	-0.20	0.14	1.00	-0.86	0.47
		4	-0.43	0.15	0.30	-1.13	0.27
		5	-0.73	0.17	0.02	-1.51	0.05

		3	-0.49	0.14	0.15	-1.24	0.26
		4	-0.88*	0.13	0.01	-1.67	-0.10
		5	-1.33*	0.13	0.00	-2.12	-0.55
		6	-1.63*	0.18	0.00	-2.46	-0.80
		7	-1.80*	0.18	0.00	-2.64	-0.97
	2	3	-0.03	0.16	1.00	-0.90	0.84
		4	-0.42	0.15	0.51	-1.34	0.50
		5	-0.88*	0.15	0.01	-1.79	0.04
		6	-1.16*	0.19	0.00	-2.08	-0.26
		7	-1.34*	0.19	0.00	-2.26	-0.43
	3	4	-0.37*	0.07	0.00	-0.74	-0.04
		5	-0.84*	0.07	0.00	-1.20	-0.49
		6	-1.13*	0.14	0.00	-1.86	-0.42
		7	-1.31*	0.14	0.00	-2.04	-0.58
	4	5	-0.45*	0.05	0.00	-0.68	-0.24
		6	-0.75*	0.13	0.01	-1.51	0.01
		7	-0.92*	0.13	0.00	-1.69	-0.16
	5	6	-0.29	0.13	0.77	-1.05	0.46
		7	-0.47	0.13	0.18	-1.23	0.30
	6	7	-0.17	0.18	1.00	-1.00	0.65
MSLR	0	1	-0.08	0.20	1.00	-1.22	1.05
		2	-0.16	0.13	1.00	-0.79	0.47
		3	-0.45	0.13	0.15	-1.10	0.20
		4	-0.74*	0.14	0.01	-1.46	-0.02
		5	-1.27*	0.13	0.00	-1.92	-0.62
		6	-1.68*	0.10	0.00	-2.14	-1.23
		7	-1.88*	0.11	0.00	-2.38	-1.39
	1	2	-0.08	0.22	1.00	-1.19	1.03
		3	-0.37	0.22	0.98	-1.48	0.75
		4	-0.66	0.23	0.32	-1.78	0.46
		5	-1.18*	0.22	0.01	-2.30	-0.08
		6	-1.60*	0.20	0.00	-2.75	-0.46
		7	-1.80*	0.21	0.00	-2.93	-0.67
	2	3	-0.29	0.15	0.92	-1.01	0.44
		4	-0.58	0.16	0.09	-1.35	0.19
		5	-1.11*	0.15	0.00	-1.83	-0.39

		6	-1.23*	0.16	0.00	-1.98	-0.50			6	-1.52*	0.13	0.00	-2.15	-0.90
		7	-1.56*	0.12	0.00	-2.22	-0.92			7	-1.72*	0.13	0.00	-2.36	-1.09
	3	4	-0.23	0.13	0.94	-0.85	0.39		3	4	-0.29	0.17	0.95	-1.07	0.49
		5	-0.54*	0.15	0.01	-1.27	0.20			5	-0.82*	0.16	0.00	-1.56	-0.09
		6	-1.04*	0.14	0.00	-1.72	-0.37			6	-1.23*	0.13	0.00	-1.89	-0.59
		7	-1.37*	0.10	0.00	-1.87	-0.88			7	-1.43*	0.14	0.00	-2.09	-0.78
	4	5	-0.30	0.16	0.91	-1.06	0.45		4	5	-0.53	0.17	0.17	-1.31	0.25
		6	-0.81*	0.15	0.00	-1.52	-0.10			6	-0.94*	0.14	0.00	-1.67	-0.22
		7	-1.13*	0.11	0.00	-1.72	-0.55			7	-1.14*	0.15	0.00	-1.87	-0.42
	5	6	-0.51	0.17	0.22	-1.29	0.28		5	6	-0.42	0.13	0.19	-1.06	0.23
		7	-0.83*	0.14	0.00	-1.57	-0.11			7	-0.62	0.13	0.02	-1.27	0.04
	6	7	-0.33	0.12	0.50	-0.98	0.33		6	7	-0.20	0.10	0.86	-0.67	0.27

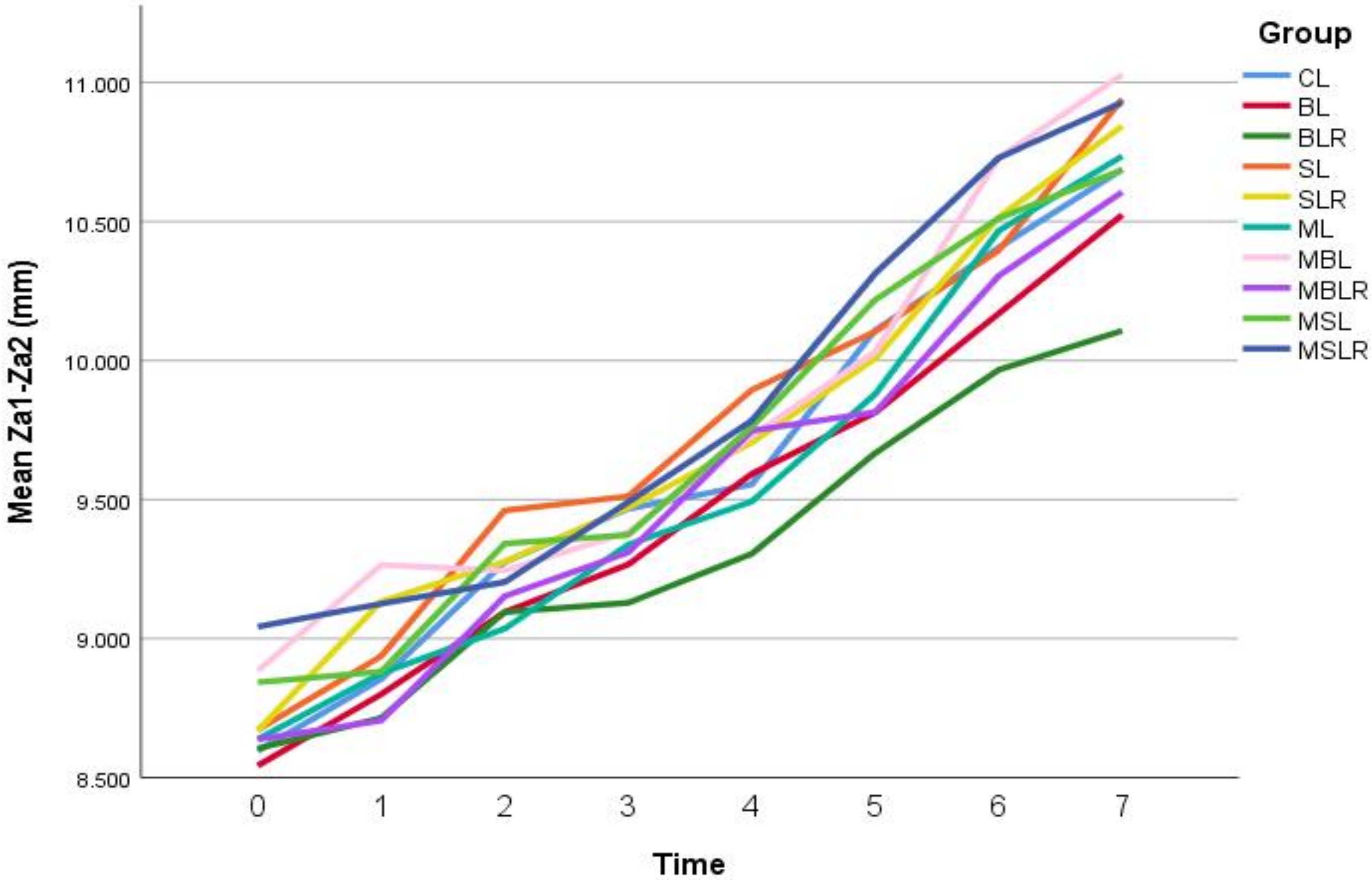


Figure 82: Line graph of mean lengths of Za1↔Za2 (mm) for DVC-LT groups at timepoints T0 to T7

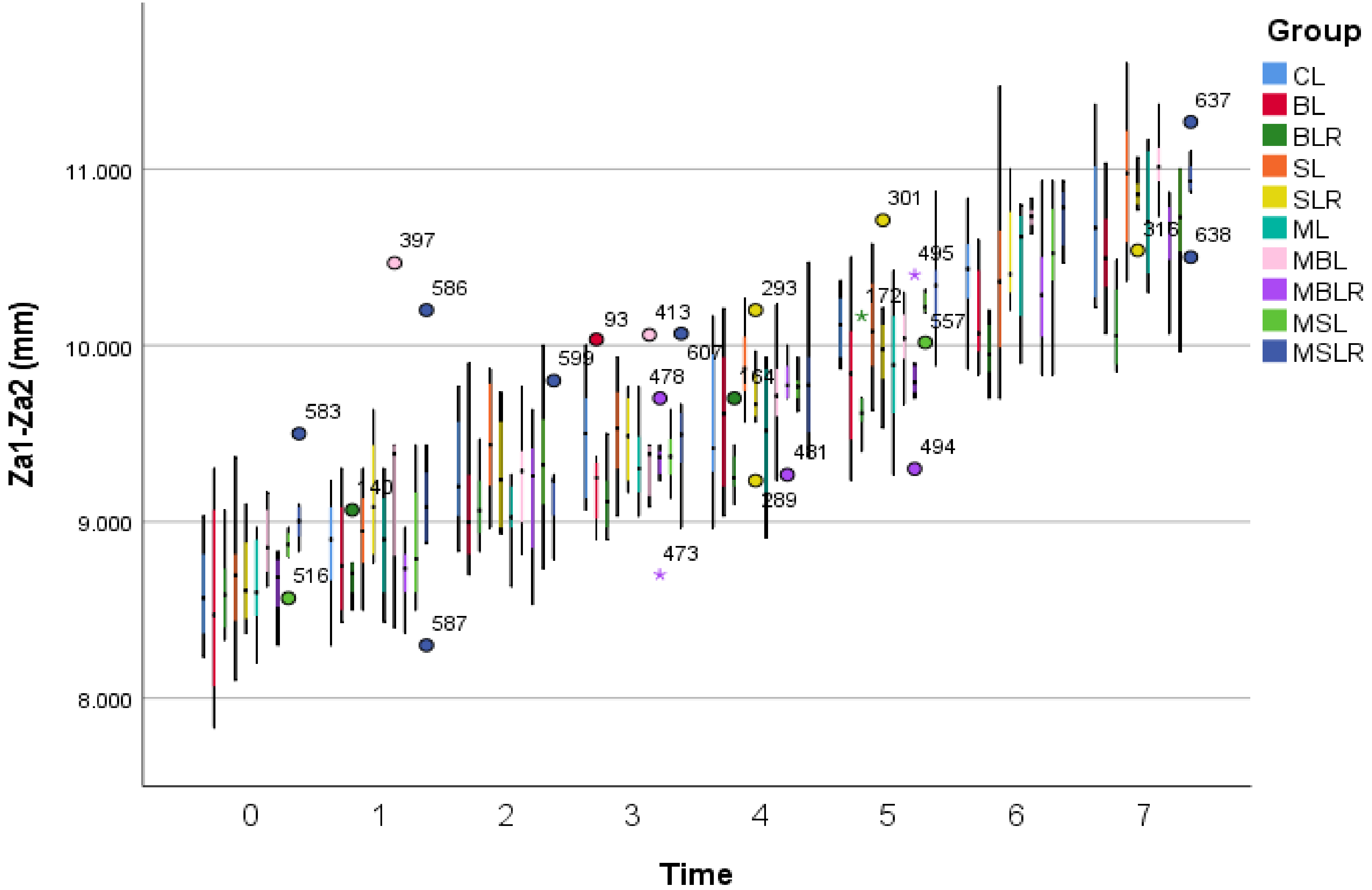


Figure 83: Boxplot of Za1↔Za2 (mm) DVC-LT groups at timepoints T0 to T7

6 DISCUSSION

Any significant skeletal findings within this study must be considered with respect to four major factors: 1. the effect of having to feed a soft-diet to all groups, 2. the effect of potentially poorer nutrition observed in the BoNT/A and the bite jumping appliance groups, 3. the effect of the relative skeletal maturity of each dimension at the time of experimental intervention, and 4. the true experimental effect due to the specific experimental interference. Relevant to this is an awareness of the magnitude of the changes observed relative to the reproducibility of the measurements (method error) and also whether the changes seen could be considered clinically as well as statistically significant.

6.1 Soft Diet Effects

The work of Kiliaridis et al. (1985 and 1995) has highlighted the implications with respect to mandibular morphology of feeding rodents a soft as compared to a normal diet. Their findings included a reduced mandibular size (Kiliaridis et al., 1985, Kiliaridis, 1995). In this study, all groups were uniformly influenced by the soft diet, and the alterations caused by a soft diet have been reported to be symmetric, with any induced morphological changes being reflected across the control, sham and experimental groups equally.

6.2 Nutrition

Malnutrition has been shown to significantly affect incremental growth rates, and to a lesser degree, the final size of craniofacial dimensions including mandibular measurements. In particular, anteroposterior measurements of the face and skull were shortened in protein malnourished animals, especially in the mandible and snout, while transverse widths and vertical heights were less affected (Miller and German, 1999).

While there was significant variation amongst the weights of the animals there were no significant differences amongst both the short-term and long-term groups with respect to the occipital to snout lengths (OSL and O↔N) and the cranial base lengths (BSL and SOS↔PBS) in both the lateral and dorsoventral radiographs (Refer to Tables XII, XXII, XXXV, and XL in Chapter 5, and Figures 84, 85, 93, 94, 98, 99, 109, 110 in Appendices 4 and 5). This was in contrast to the findings of an earlier pilot study where those groups injected with BoNT/A had significantly shorter occipital to snout lengths and cranial base lengths. In this work, with veterinary consultation, all groups were fed Nutrigel® in addition to the moistened rat chow. Nutrigel® consists of a combination of fats, proteins, and carbohydrates and additionally contains vitamins A, D, E, B1, B2, B6, B12, Nicotinamide, Calcium Pantothenate, Folic Acid, Iron, Manganese, Magnesium and Iodine, which is equivalent to 1500 kilojoules of metabolisable energy per 100g of the gel. It is likely that the addition of this nutritional gel across all groups helped to reduce malnutrition and thus explains the lack of significance in the overall size of the craniofacial measurements although malnutrition will be considered when assessing the results.

6.3 Relative Skeletal Maturity

Previous studies have shown that not all absolute growth curves of the rat are linear, such as body weight and bi-zygomatic width increases which both display quadratic curves (VandeBerg et al., 2004). These differences must be kept in mind when assessing relative changes in growth pattern. Also, considerable variation in the relative maturity of craniofacial features exists in rats as it does in humans. In other words, the amount of total maturity a feature has achieved at a given point in time is not necessarily equal to the maturity of other measurements of the face and skull (VandeBerg et al., 2004, Abed et al., 2007). For example, neurocranial components tend to be more mature earlier than those associated with the face or viscerocranium (VandeBerg et al., 2004). It is logical to believe that a particular facial structure which still has considerable growth remaining may be more susceptible to an insult delivered locally or systemically at that time. This is true experimentally. Craniofacial development has been shown to be susceptible to factors such as softened diet, or growth hormone treatments, relative to the maturity of each particular structure (Singleton et al., 2006, Abed et al., 2007). The most immature skeletal components are the most affected at the time of experimentation. Interestingly, the possibility of rebound growth later cannot be ruled out, as more catch-up growth has been observed in features which showed the least maturity at the time of intervention (Singleton et al., 2006, Abed et al., 2007).

With respect to the anterior lateral and posterior temporalis muscles, relevant skeletal insertions include the squamosal and/or parietal bones. Although cranial width reduction has been demonstrated in association with temporalis resection, the issues of scarring and infringement of bony blood supply cannot be ignored (Brennan and Antonyshyn, 1996). No significant asymmetry was found amongst cranial widths in this present study (Refer to Tables XXXV and XL in Chapter 5, and Figures 104 and 115 in Appendix 5). Of note, cranial width displays almost 100 percent maturity relative to other neurocranial and viscerocranial dimensions in rats aged 22 days (Abed et al., 2007). Although the neurocranium grows for a longer time period and with much smaller growth increments than those of the viscerocranium, primarily the size of the neurocranium responds to brain enlargement, hence muscular function may have minimal impact on cranial dimensions (Young, 1959).

According to VandeBerg et al. (2004), the slope of the mandibular growth curve was steepest at the beginning of the experimental period, followed by the growth curve of the maxillary anteroposterior position, and then by the cranial growth curves (VandeBerg et al., 2004). According to growth hormone levels, puberty in the rat begins at 28 days and concludes after 63 days (Gabriel et al., 1992). This period mimics the treatment window time-period of human patients (VandeBerg et al., 2004). This knowledge reinforces the chosen treatment time period for this study aimed at early to mid-puberty and suggests that the mandible was theoretically amenable to experimental interference.

6.4 True Experimental Effects

6.4.1 Craniofacial Alterations as a Result of Bone Remodeling

Alteration of biomechanical forces affect vascular diffusion efficiency and bone turnover, and consequently bone modeling (Roberts and Hartsfield, 2004). The implications of reduced muscular traction include altered skeletal size and/or shape. Theoretically, any skeletal structure serving as a muscular attachment may be affected by BoNT/A induced paralysis and this will be considered in addition to overall displacement of skeletal structures, although, as highlighted above the relative maturity at the age of insult is likely to affect the outcome.

6.4.2 Previous Bite Jumping Studies Involving Rodents

Although the findings of numerous animal studies which have assessed bite jumping appliances have been previously discussed in Chapter 2, it is worth highlighting that there are few radiographic studies that exist involving rats and bite jumping appliances. Even then, the radiographic measurements have been limited to the mandible leaving a void in the useful data available for comparison. The position of the mandible is dictated by the overall projection of the mandible from the glenoid fossa, and hence the position of the fossa also dictates the horizontal position of the lower jaw within the face. The literature indicates that many authors have used animals of varying sex and ages, outbred animals, and different appliance designs, which together add to the confusion. These factors indicate the unique nature of this present study.

A cephalometric study on 56 day old male, Wistar rats by Oksayan et al. (2014) using a bite jumping appliance similar to that developed by Xiong et al. (2004) with an unspecified amount of advancement, focused solely on mandibular measurements and found that the length of the mandible (Co to Dg) increased within the appliance groups compared with controls after 30 days of wear (Xiong et al., 2004, Oksayan et al., 2014). This study also found no increase in condyle to ramal vertical development after bite jumping appliance wear, nor did Charlier and co-authors (Charlier et al., 1969). Taira and co-workers studied 28 day old male, Wistar rats that underwent intervention with an upper bite jumping appliance which apparently produced 3.5 mm of horizontal and 3 mm of vertical mandibular projection. The appliance was in place for 4 weeks and serial radiographs were taken weekly. Their results showed that bite jumping appliances, without any additional intervention, did not lead to any additional Co to Dg distance increase nor an increase in vertical height of the mandible above the controls (Taira et al., 2009). A criticism of these works is the design of the appliance as previously discussed and the lack of consideration for growth of the incisors.

6.4.3 Lateral Cephalometric (LC) Measurements

6.4.3.1 LC Maxillary Measurements

The projection of the maxilla from the cranial base showed backwards movement in the short-term (ST) groups M and MS from T1 to T3. This was also observed in the long-term (LT) groups whereby the ML, MSL, and MSLR groups had reduced maxillary projection from T1 to T3. The horizontal projection of Uii (xUii) also showed negative gain in length in the M and MS groups from T1 to T3 in the ST groups. The ML, MSL, and MSLR groups displayed a reduced gain in length of xUii compared with the other groups from T1 to T3.

From T4 onwards there were no further significant differences in the S to Uii projection although all appliance groups finished with slightly shorter S to Uii length. However, at T5 and T7 the BLR group showed significantly smaller incremental gains in S to Uii. It is of note that the BLR group finished with the lowest overall body weight at T7. As mentioned earlier, it has been shown that anteroposterior measurements of the face and skull may be reduced in protein malnourished animals, especially in the mandible and snout, while transverse widths and vertical heights were less affected (Miller and German, 1999). It is a possibility that the anteroposterior development of the maxilla in the repeat BoNT/A group was due to an element of malnutrition. It was also observed that the MBLR groups were able to obtain food more easily than the BLR groups through the sides of their mouths due to their increased opening when the appliance was in place. It is possible that the MBLR group was better able to thrive during their juvenile development and thus a reduced development of the maxilla was not statistically significant by T7.

The contemporary biomechanical understanding of bite jumping appliances suggests that the appliance produces stretch of the mandibular closing (and circum-oral) muscles which subsequently attempt to return to their resting lengths. This transfers a posteriorly directed force to the upper incisors and/or maxilla (Freer, 1999). Past literature has suggested that functional appliances may retard or redirect maxillary growth in humans and a number of studies have shown that growth at the anterior nasal spine (ANS) can be inhibited by functional appliance therapy (Jakobsson, 1967, Harvold and Vargervik, 1971, Pancherz, 1997). Similarly, Ghafari et al. reported restraint of maxillary growth with the Frankel regulator (Ghafari et al., 1998). However, some studies do not demonstrate this to be true to any great degree (Livieratos and Johnston, 1995, Keeling et al., 1998). Additionally, as most studies use A-point that is subject to considerable dentoalveolar modification via movement of the maxillary incisors, to evaluate sagittal maxillary position, a true answer is difficult to ascertain.

During appliance wear, all appliance groups showed a reduced anterior projection of maxillary measurements (S to Uii, and xUii) except for those groups that had undergone injections with BoNT/A. This would support the conventional understanding of bite jumping mechanics whereby a retractive force is delivered to the upper jaw and dentition. This also supports the knowledge that BoNT/A inhibits the stretch-reflex with less distally directed force being placed on the anterior maxilla. The results of this study would suggest that the muscular pull-back does provide some distally directed force to the maxilla while the appliances are in place with catch-up growth being a possibility after appliance removal.

6.4.3.2 LC Mandibular Measurements

6.4.3.2.1 Length of the Mandible (Co to Dg)

While no statistically significant differences were found between the groups at any time point for overall mandibular length, the MBL and MBLR groups did demonstrate longer mandibular lengths at the end of appliance wear and at the final timepoint than any other group. From T3 until T6 the BLR group did have the lowest overall length of Co to Dg.

Overall, these results within the BoNT/A injection groups (without appliances) support those of Kwon et al. (2007) who also found no significant differences in the overall length of the mandible after BoNT/A injections in rabbits (Kwon et al., 2007). On the other hand, Kim et al. (2008) did find a shortened Co to Dg length in their BoNT/A injection groups however this was not statistically different to the control or saline groups as with this present study (Kim et al., 2008). Tsai et al. (2009) found the measurement Co to Dg to be shortened in their BoNT/A injection groups (Tsai et al., 2009) although this study did not offer specifics about the nutrition of the animals. A micro-computed tomography study on 28 day old, male, Sprague-Dawley rats found that unilateral BoNT/A injections to the masseter muscle produced statistically significant reductions in the length of Co to Dg, but it is worth noting that a significant cutaneous incision was made to visualize the injection sites and thus scarring occurred, and possibly, decreased nutrition and general wellbeing while recovering from the incision, which may have significantly affected the results (Chen et al., 2015).

In contrast to the findings within the appliance groups of this current study, as previously mentioned, a cephalometric study on 56 day old male, Wistar rats using a bite jumping appliance found that the length of the mandible (Co to Dg) increased within the appliance groups compared with controls after 30 days of wear (Oksayan et al., 2014). It is worth noting that the rats in this study started bite jumping therapy very close to the end of their pubertal growth. However the results of this current study are in agreement with Taira et al. whereby it was found that bite jumping appliances did not lead to any additional Co to Dg length (Taira et al., 2009). It would appear from the results of this present work that while some small increase in mandibular length may be possible, the length of the mandible is primarily genetically driven.

6.4.3.2.2 Postured Length of the Mandible (Ar to Dg)

In the short-term groups, as expected, with a bite jumping appliance in place, the Ar to Dg lengths were increased in the appliance groups (M, MB, MS) from T1 until T3, but these changes were only statistically significantly longer for the MB group. This increased protrusion in the group with BoNT/A injections may indicate less muscular retraction force from the masseter and temporalis muscles. In the long-term groups, the BLR group had a shorter Ar to Dg length from T2 until T7. It is reasonable to consider that perhaps this reduction in Ar to Dg length was due an increased mandibular plane angle possibly due to reduced postural tension in the jaw closing muscles in this group, however this was not the case. As mentioned, the BLR group finished with the shortest Co to Dg length although this difference was not significant in comparison with the other groups. Also the xLis measurements from T5 to T7 were reduced, reinforcing that a true decrease in mandibular length occurred within the BLR group. While a nutritional deficiency within this group cannot entirely be ruled out as the mean weight was the lowest at T7, it would appear that the development of the length of the mandible is dependent on normal masticatory function.

6.4.3.2.3 Condylar Position

There were no differences between the vertical positions of variable yCo (Tables XIII and XXII in Chapter 5, and Figures 89 and 95 in Appendix 4) in either the short or long-term groups. This may reflect the relatively flat articular fossa and eminence in the rodent allowing forward positioning of the condyle during the protrusion caused by appliance wear without altering the vertical position (Luder, 1996).

While there were no initial significant differences (T0) in the horizontal projection of the condyle (xCo) for either the short or long-term groups, once the appliances were inserted, all appliance groups showed a more anterior position of the condyle. All appliance groups except those used in conjunction with BoNT/A showed a relapse of condylar position towards that of the controls from T4, however the condyle in the ML, MSL, and MSLR groups was still slightly more anterior than control and sham groups without appliances by T7. Interestingly both the MBL and MBLR groups showed significantly more anterior condylar positions, which were maintained at T7. As the MBL group, which recovered from BoNT/A paralysis of the temporalis and masseter muscles, was not significantly different to the MBLR group, with sustained partial paralysis, it would appear that the lack of muscular pull-back allowed some remodeling of the condyle and articular eminence to a more forward position relative to the cranial base during appliance wear. It would also seem that BoNT/A injections are not required long term to maintain a more anterior condylar position.

The current results are in contrast with Chayanupatkul et al. (2003) who studied early (30 days of wear) and late (44 days of wear) removal of bite jumping appliances on female, 35 day old Spraque-Dawley rats. Histomorphometric measurements showed bone formation in the condyle and posterior glenoid fossa during appliance wear, however subsequently the amount of bone formation was similar to the controls (Chayanupatkul et al., 2003). The findings in the present study are in support of new bone formation at the post-glenoid spine in response to bite jumping appliance wear in line with previous animal studies (McNamara and Carlson, 1979, Hinton and McNamara, 1984, Woodside et al., 1987, Voudouris et al., 2003a). These findings also suggest that muscular forces may play a role in relapse of an improved condylar and/or glenoid fossa position.

6.4.3.2.4 Vertical and Horizontal Lengths of the Mandibular Ramus

There were no significant differences in the vertical height of the mandibular ramus (Co to Mn) or length of the ramus (Go to Ag) in either the short or long-term study groups from T0 until T3. However, amongst the long-term groups from T4 until T7 the BLR group had a significantly reduced ramal height and length. The MBLR group also showed a reduced ramal height from T4 and T6 although this was not statistically significant at the final timepoint.

Chen et al. (2002) also noted a significantly shorter ramal height after unilateral BoNT/A injections in 28 day old rats (Chen et al., 2002). This reduction in vertical and horizontal development of the mandibular ramus in conjunction with repeated BoNT/A injections is consistent with the effect on the attachment of the deep masseter muscle along the ramus and gonial process (Weijs, 1973). The reduced anteroposterior development of the gonial process was also supported by the Go to Lii results (below) and the Dorsoventral Cephalometric (DVC) results. These findings are also consistent with the findings of previous studies (Kwon et al., 2007, Babuccu et al., 2009, Tsai et al., 2009). It is worth considering that the results which are most likely to be true experimental effects as observed on the lateral cephalograms are those in the vertical plane as these have been shown to be less affected by poor diet (Miller and German, 1999).

6.4.3.2.5 Length of the Lower Border of the Mandible (Go to Lii) and the Horizontal Projection of the Mandible (xLis)

The lower border of the mandible (Go to Lii) did not show any significant changes until T4 and T5 at which point the BLR group had shorter Go to Lii lengths. A morphometric study by Kim and co-workers, based on findings from 28 day old rats who underwent BoNT/A injections, found there to be a reduction in the length of the lower border of the mandible after 4 weeks. However this was not significantly different from control or saline injection groups (Kim et al., 2008). Tsai et al. (2009) also found the lower border of the mandible to be significantly shorter than controls after BoNT/A injections to the masseter muscle of juvenile rats as did Babuccu et al. (2009) (Babuccu et al., 2009, Tsai et al., 2009). A micro-computed tomography study on 28 day old, male, Sprague-Dawley rats found that after unilateral BoNT/A injections to the masseter muscle, statistically significant reductions in the length of the lower border of the mandible resulted, although the effect of the open incision and subsequent scarring has been mentioned previously (Chen et al., 2002).

It is likely that the reduction in length of the lower border of the mandible may be the result of remodelling and shortening of the gonial process in response to reduced deep masseter muscle function in the BoNT/A and appliance groups.

The BLR group did have the lowest xLis measurements from T5 to T7 and in line with the findings of a reduced total mandibular length (Co to Dg) and postured length (Ar to Dg) indicating a truly smaller mandible in this group. The horizontal projection of the mandible (xLis) was found to be very slightly but significantly reduced during appliance wear in both the short-term groups (M and MS), and the LT (MBL, MBLR, and MSLR) groups. This could be considered as the result of the backwards rotation of the mandible whilst the appliances were in place. However, the MBL and MBLR groups showed increased xLis lengths at the end of the study, indicating that the lower jaw was further forward than in the remaining groups despite an increased mandibular plane angle. It is difficult to compare this finding with previous rodent studies as none are apparent and those studies that have been conducted on rodents have studied the mandible in isolation as opposed to the position of the mandible relative to the maxilla and cranial base. In humans, it is purported that bite jumping appliances will not grow the mandible to any great effect (Tulloch et al., 1998, Tulloch et al., 2004). However these findings do suggest a slight gain in anterior mandibular position.

6.4.3.3 LC Intermaxillary Measurements

6.4.3.3.1 LC Mandibular Plane Angle and Angle of Opening

While the bite jumping appliances were in place, both the short and long-term appliance groups showed an increase in the mandibular plane angles from T1 until T3. The MPA of the MBL group recovered to the level of control and sham groups by T5. The MPA of the MBLR group showed a more gradual decrease from T4 and remained higher than all other groups at T7. The BLR group had an increased MPA at T5 and T6 although this recovered somewhat by T7.

The fact that the BLR and the MBLR groups had larger mandibular plane angles until T6 and T7 respectively, may reflect some over-eruption of the molars in these groups. A short-term human study has observed over-eruption of the molars and increased vertical facial measurements in adolescents undergoing functional appliance treatment (Nelson et al., 1993). It has been established in both humans and animals that weak biting forces and reduced masticatory musculature lead to increased vertical dimensions (Pepicelli et al., 2005, Hunt et al., 2006). In humans, several studies have demonstrated that a reduced MPA is associated with stronger biting forces (Ingervall and Helkimo, 1978, Ingervall and Bitsanis, 1987, Hunt et al., 2006). While the ML group had an increased opening at T5 the jaw closing muscles were able to exert greater biting forces that may have led to faster recovery of the MPA. In parallel with the increase in MPA, the angle of opening was also increased for the appliance groups during appliance wear and recovered after appliance removal. It would appear from these results that BoNT/A injections are not required long term to maintain a more anterior condylar position and actually serve to negatively affect the vertical facial dimensions. The results here reinforces the need for vertical control during bite jumping therapy (Williams and Melsen, 1982).

6.4.3.3.2 Overjet

There were no significant differences in the overjet during the periods T0 to T3. During appliance wear, the appliance groups had increased angles of opening and mandibular plane angles. Any potential reduction in overjet in the appliance groups during bite jumping therapy may have been negated by the clockwise rotation of the lower jaw, with the appliances in place. Although the MBL and MBLR groups had lower overjets at T4 and T5 these were significantly lower at T6 and T7 only. This may have been due to further lowering of the mandibular plane angle. As there were no significant differences with respect to the anteroposterior position of the maxillary measurements between the groups at these timepoints, this does indicate a true forward position of the lower jaw in these groups. It has previously been reported that bite jumping appliances induced a reverse overjet in rats (Xiong et al., 2004).

6.4.4 Dorsoventral Cephalometric (DVC) Measurements

6.4.4.1 Anteroposterior Position of the Gonial and Coronoid Processes

At T1 through to T3 all of the short and long-term appliance groups logically showed a more anterior position of both the gonial and coronoid processes and this has been visualized in other bite jumping studies in rodents (Tsolakis and Spyropoulos, 1997). The flat anatomy of the rodent glenoid fossa is such that protrusion involves relatively straightforward translation of the condyles as opposed to the rotation and translation seen in other animals, including humans (Luder, 1996). However, the anterior positions of the gonial and coronoid processes were only significantly different in those groups with the combination of BoNT/A and the bite-jumping appliances. This significant finding suggests the influence of the BoNT/A on gamma motor-neurons thus reducing the stretch reflex (Filippi et al., 1993).

The DVC long-term groups showed that the gonial processes were more anterior for the MBL and MBLR groups at T4 and T5 groups however there were no significant differences by T7 between the groups. After the appliances were removed there were no differences between the groups for the anteroposterior positions of the coronoid process between any of the long-term groups. Interestingly, as noted above, the xCo positions of the MBL and MBLR groups were more anterior than the other groups by T7. However, if the mandibles of all animals were of similar size one would expect that the gonial and coronoid processes would also be more anterior.

The attachment of the deep masseter muscle encompasses the widest and most posterior limit of the angular process (Go or gonion), the mandibular body, and the zygomatic arch and length (Za↔Zp). It is likely that local remodelling was occurring at the gonial and coronoid processes independently due to the attachments of the temporalis and deep masseter muscles as well as an overall shift in position, or that catch-up growth of these structures occurred. Both physical and chemo-denervation (via BoNT/A injections) have previously been shown to reduce the size of the gonial and coronoid processes in three dimensions (Carter and Harkness, 1995, Navarro et al., 1995, Babuccu et al., 2009, Chen et al., 2015).

6.4.4.2 Intergonial and Intercoronoid Widths

Within the short-term study, the M, MB, and MS groups had narrower intergonial widths than the C, B, and S groups from T1 to T3, however this was only statistically significant for the M and MB groups. From T1 to T3 the long-term appliance groups had narrower intergonial widths along with the BoNT/A groups BL and BLR groups. The short-term study groups also had narrower intercoronoid widths than the C, B, and S groups from T1 to T3, but again this was only significant for the M and MB groups. The BoNT/A repeat injection groups (BLR and MBLR) showed narrower intergonial and intercoronoid widths until T6 however by the final timepoint, T7, there were no significant differences in intergonial or intercoronoid widths.

The appliance groups (M, MB, MS) had significantly increased angles of opening (AoO) from T1 to T3. This was also true for the long-term appliance groups (ML, MBL, MBLR, MSL, MSLR) during appliance wear. It is known that the human mandible can flex inwards around the mandibular symphysis by approximately 1mm upon opening, leading to a decrease in mandibular width (Sivaraman et al., 2016). This mandibular flexion occurs because the lateral pterygoid muscle originates on the lateral pterygoid plate and runs disto-laterally to insert onto the mandibular condyle. Contraction of the lateral pterygoid muscle upon opening pulls the mandibular condyles medially leading to a narrowing of the mandible (Goodkind and Heringlake, 1973). Similar to humans, the direction of contraction of the lateral pterygoid muscle in rodents also leads to a narrowing of the mandible (Cox and Faulkes, 2014). However, with bite jumping appliances in place the lateral pterygoid is passive (Sessle et al., 1990), and thus flexure of the mandible is unlikely to be the cause of the observed changes in intergonial and intercoronoid widths. It is more likely that the lack of normal function within the appliance groups, and also in those groups with BoNT/A injections whereby the masseter and temporalis muscles were partially paralysed, that local remodelling of the gonial and coronoid processes was occurring. As previously mentioned, the gonial and coronoid processes have been shown to be adaptive to functional interference in three dimensions (Carter and Harkness, 1995, Navarro et al., 1995, Babuccu et al., 2009, Chen et al., 2015).

6.4.4.3 Zygomatic Arch Widths

Whilst there were no significant differences between posterior (Zp1↔Zp2) or anterior (Za1↔Za2) zygomatic arch widths in either the short or long-term groups from T0 until T3, from T4 through to T7 the BoNT/A repeat injection group (BLR) had significantly narrower posterior and anterior zygomatic arch widths. Curiously the MBLR group did not show similarly significantly reduced zygomatic widths although at T7 the anterior and posterior zygomatic widths in this group were reduced compared to all other groups except the BL and BLR groups. At T4 and T5 the MBL group also showed reduced posterior zygomatic widths; however there was no difference in the anterior width of the arch.

A study by Babuccu et al. (2009) using BoNT/A injections on 15 day old rats found significant reductions in zygomatic width at age 4 months. It is important to note that the rats used in this study were very young and the development of the zygomatic arches less mature than in this current study. Although significant asymmetry with respect to zygomatic length has been noted in a BoNT/A study impeding the superficial and deep masseter muscles in New Zealand white rabbits, the attachment of the powerful superficial masseter to the zygomatic arch in this species, unlike in rats, may have induced these findings (Kwon et al., 2007). In a study by Tsai et al. (2009) the results did not show significant asymmetries of zygomatic arch width (Tsai et al., 2009). The attachment of the deep masseter muscle to the length of the zygomatic arch in rats would suggest that the resulting reduction in widths in the BLR group were due to lack of function of this muscle, however as the MBLR group was not similarly affected, the possibility of a nutritional deficiency within the BLR group, contributing to the findings, cannot be excluded (Weijs, 1973).

6.5 Considerations of the effects of BoNT/A

6.5.1 Diffusion and Doses

Provided injection placement during this study was accurate, the risk of BoNT/A diffusion was low at the given volumes used (Hsu et al., 2004). Furthermore, previous animal studies have indicated that when diffusion occurs within the muscle, muscle compartments and fascial planes limit diffusion by up to 23% (Shaari and Sanders, 1993). There is the possibility that diffusion to the superficial masseter may have occurred if injection placement was inaccurate, potentially resulting in a more severe functional impairment during mastication. Measurements reflecting malnutrition, except for the possibility of the BLR group which finished with the lowest body weight, were not found amongst the groups.

6.5.2 BoNT/A Effect on Bone

Kwon et al. (2007) found that improvement in mandibular bone volume occurred in the long-term in rabbits following paralysis resolution. Rapid and significant trabecular and cortical bone loss primarily achieved by resorption, or reduced mineralization has been shown to result from BoNT/A injections to the mouse hind limb and which does not necessarily recover upon restoration of muscle function in the long-term (Warner et al., 2006, Grimston et al., 2007).

A more contemporary study involving micro-computed tomography found that unilateral BoNT/A injections (2 U of Botox®) into the masseter and temporalis muscles of adult (126 days old) rats led to reduced condylar and alveolar bone density 4 weeks after injection; although cortical thickness was not reduced (Kun-Darbois et al., 2015). This study was short-term only and did not assess recovery long-term. Furthermore, the authors were not specific regarding their injection placement and thus it was difficult to assess whether the deep or superficial masseter muscles, or both, were injected. As the deep and superficial masseter muscle have differing functions, it is possible that the powerful superficial masseter muscle, a jaw protruder, was paralysed contributing significantly to the reduction of cortical bone loss. Consideration must be given to the long-term skeletal sequelae of BoNT/A injections.

6.5.3 Clinical Safety of BoNT/A

For an agent to be useful therapeutically or experimentally, it should be safely tolerated. Diffusion of the BoNT/A to adjacent muscles, possibly due to poor injection technique, is the most common adverse event, leading to temporary weakening and/or drooping of adjacent muscles (Naumann and Jankovic, 2004, Ramachandran and Eastwood, 2006). BoNT/A use is contraindicated in pregnancy and lactation, in concurrence with certain medications including non-polarizing neuromuscular blockers and aminoglycoside antibiotics, and in patients with neuromuscular diseases such as myasthenia gravis (Molgo et al., 1987 , Tan and Jankovic, 2000, Carruthers and Carruthers, 2004, Clark et al., 2007).

A meta-analysis conducted by Naummann and Jankovic (2004) concluded that BoNT/A (Botox) has a good safety profile across all therapeutic uses. Although focal weakness was reported with greater frequency with BoNT/A injection compared with controls, there were no significant differences in the frequency of pain or reaction at the injection site compared with controls. None of the studies reported the occurrence of any systemic adverse reactions (Naumann and Jankovic, 2004). Arrhythmia and myocardial infarction have been reported post-injection, however these cases are rare and the patients had pre-existing disease (Clark et al., 2007). The literature reports only one possible fatal anaphylactic reaction to combined BoNT/A and lidocaine injection in the United States for the treatment of neck and back pain; the cause of death was determined to be anaphylaxis to the Botox®-lidocaine mixture and could not be attributed to Botox® alone (Li et al., 2005). However, there is little literature on allergy to BoNT/A and in view of the emergence of this drug into new fields, it is exceedingly important for the clinician to be aware of the potential for allergic reactions. Further research is required to gain knowledge about the long-term effects of sequential muscle denervation, especially with regard to muscle fibre atrophy and potential muscle weakness (Ramachandran and Eastwood, 2006).

As the effect of BoNT/A dissipates with time, repeated treatments are required in many situations (Aoki, 2005) One retrospective 10 year study found that less than 10 per cent of patients treated therapeutically with BoNT/A for hemifacial spasm, blepharospasm and cervical dystonia showed primary resistance and 7.5% developed secondary resistance with repeated treatments (Hsiung et al., 2003). Another paper reported the overall prevalence of resistance to BoNT/A to be less than 5% (Klein, 2005). However it should be noted that very little research has been undertaken on the long-term effects of continued BoNT/A use.

6.5.4 The Complexity of BoNT/A as a Research Tool

BoNT/A can also reduce release of other neurotransmitters, including epinephrine and norepinephrine (Aoki, 2005). Further, an anti-nociceptive quality is noted for BoNT/A via central modulation of the afferent pathways and a reduction of the release of pain mediators: substance P, calcitonin-gene-related peptide (CGRP), and glutamate (Zalvan et al., 2004). To speculate on the potential effects on skeletal homeostasis and/or muscle function resulting from the reduction of these neurotransmitters is far beyond the scope of this work. It should be noted though, that BoNT/A is a complex research tool and should not be assumed to be simple when analysing results. Further explorations of BoNT/A cellular mechanisms are ongoing and warranted.

7 CONCLUSIONS

The primary aim of this project was to examine the short and long-term craniofacial skeletal effects of bite jumping appliance therapy and/or BoNT/A injections to the temporalis and deep masseter muscles in the rodent model. A secondary aim was to evaluate the effects of BoNT/A longer term on skeletal growth. These effects were studied through the measurement of standardised lateral and dorsoventral cephalometric radiographs. Based on the findings of the study, the following conclusions can be drawn:

Appliance Groups (without BoNT/A) (M, ML, MS, MSL, MSLR)

With respect to the control and sham-injection appliance groups the following conclusions can be drawn:

Lateral Cephalometric Conclusions

- The maxillary anteroposterior projection from the cranial base was reduced during appliance wear although there was some recovery in this measurement after appliance removal giving support to the theory that, via the stretched circum-oral muscles, a distal force is applied to the maxilla and upper dentition.
- The appliance groups showed no significant increases in mandibular length (Co to Dg) length in the long-term.
- The postured length of the mandible (Ar to Dg) was increased with the appliances in place however this returned to similar measurements as control and sham groups after appliance removal.
- Once the appliances were inserted, all appliance groups showed a more anterior position of the condyle (xCo) a relapse of condylar position towards, but not quite to the same level as the controls, occurred after appliance removal.

- The horizontal projection of the mandible (xLis) was found to be very slightly but significantly reduced during appliance wear in both the short-term groups (M and MS), and the long-term (MSLR) groups.
- The short and long-term combination groups showed an increase in the mandibular plane angle (MPA) and angle of opening (AoO) during appliance wear. These angles recovered after removal of the appliances.

Dorsoventral Cephalometric Conclusions

- During appliance wear all short and long-term groups showed a more anterior position of both the gonial and coronoid processes however this relapsed to the level of control and sham groups after appliance removal.
- Narrower intergonial and intercoronoid widths were found for the appliance groups during appliance wear, likely due to local remodelling.

BoNT/A Groups (B, BL, BLR)

With respect to the BoNT/A injection groups the following conclusions can be drawn:

Lateral Cephalometric Conclusions

The BLR group had:

- a significantly reduced maxillary projection
- the lowest overall mandibular length (Co to Dg) and postured mandibular length (Ar to Dg) a the final timepoint
- a significantly reduced vertical height of the mandibular ramus (Co to Mn) and ramal length (Go to Ag) from T4 until T7
- a transiently shorter lower border of the mandible (Go to Lii) at T4 and T5 although this was not significant at the end of the experimental period
- a significantly reduced anteroposterior projection of the mandible (xLis) at the final timepoint, and
- an increased MPA at T5 and T6 although this recovered somewhat by T7.

Dorsoventral Cephalometric Conclusions

The BLR group had:

- narrower intergonial and intercoronoid widths until T6 however by the final timepoint, T7, there were no significant differences in intergonial or intercoronoid widths.
- From T4 through to T7 the BLR group had significantly narrower posterior and anterior zygomatic arch widths from T4 until the final timepoint.

These results suggest that in the long-term, normal masticatory function is important for the skeletal development of the maxilla and mandible. Additionally, weakened jaw-closing muscles appear to be associated with molar over eruption. However, the possibility of a nutritional deficiency within the BLR group that may have contributed to the results cannot be excluded.

Combination of BoNT/A and Appliance Groups (MB, MBL, MBLR)

Lateral Cephalometric Conclusions

- Within the combination groups, while the maxillary projection was slightly reduced compared with controls and sham groups. Maxillary length was not as reduced as in the appliance, and sham injection appliance groups.
- The MBL and MBLR groups finished with the highest overall mandibular length (Co to Dg) although this was not statistically significant.
- The postured length of the mandible (Ar to Dg) was increased with the appliance in place as expected and was longer in the combination groups compared with the appliance and sham injection appliance groups.
- The MBL and MBLR groups finished with the greatest overall postured length although these measurements were not significantly different.
- During appliance wear, all combination groups showed a more anterior position of the condyle (xCo) however there was minimal relapse after appliance removal in the MBL and MBLR groups with respect to anteroposterior condylar position and this was maintained at the final timepoint.
- The MBLR group also showed transiently reduced ramal height (Co to Mn) and length of the lower border of the mandible (Go to Lii) although these measurements were not significant by T7.
- The horizontal projection of the mandible (xLis) was found to be very slightly but significantly reduced during appliance wear in both the short-term and long-term combination groups. However, the MBL and MBLR groups showed increased xLis lengths at the end of the study, indicating that the lower jaw was further forward than in the remaining groups.
- While the appliances were in place, both the short and long-term combination groups showed an increase in the mandibular plane angles from T1 until T3.
- The MPA of the MBL group recovered to the level of control and sham groups by T5. The MPA of the MBLR group showed a more gradual decrease from T4 and remained higher than all other groups at T7, again highlighting the need for increased vertical control throughout bite jumping appliance therapy.
- At T1 through to T3 all combination groups logically showed a more anterior position of both the gonial and coronoid processes with the appliances in place suggesting that BoNT/A reduces muscular resistance. The gonial processes were more anterior for the MBL and MBLR groups at T4 and T5 groups however there were no significant differences by T7 between the groups. Narrower intergonial and intercoronoid widths were found for the MB groups from T1 to T3. The MBLR showed narrower intergonial and intercoronoid widths until T6 however by the final timepoint, T7, there were no

significant differences in intergonial or intercoronoid widths.

Dorsoventral Cephalometric Conclusions

- At T1 through to T3 all combination groups logically showed a more anterior position of both the gonial and coronoid processes. The gonial processes were more anterior for the MBL and MBLR groups at T4 and T5 groups however there were no significant differences by T7 between the groups.
- Narrower intergonial and intercoronoid widths were found for the MB groups from T1 to T3. The MBLR showed narrower intergonial and intercoronoid widths until T6 however by the final timepoint, T7, there were no significant differences in intergonial or intercoronoid widths.

From the results for those animals treated with both BoNT/A injections and appliances it would appear that the mandibular length (Co to Dg) is slightly modifiable in terms of dimension however, the anteroposterior position of the condyle (xCo) and glenoid fossa appears to be more amenable to orthopaedic intervention. It would also seem that BoNT/A injections are not required long term to maintain a more anterior condylar position after initial bite jumping therapy and actually serve to negatively affect the vertical facial dimensions.

Based on the above conclusions, the null hypothesis that BoNT/A induced partial paralysis of the temporalis and deep masseter muscles of the juvenile rat during bite-jumping appliance wear will have no influence on craniofacial skeletal growth, over the short-term or long-term, with or without a retention regime involving continued BoNT/A application, can be rejected.

In summary, the results of this work tend to support the 'Myotatic Biomechanical Theory of Bite Jumping Appliances' and also, that perhaps each skeletal component has a genetically predetermined length, height, and/or width. However, there is a portion of each dimension that may be modified, by experimental intervention of extrinsic muscular forces and/or bite jumping appliances. It is also possible that the amount of change is influenced by certain key factors to which the magnitude of adaptation achieved is likely to be proportional, including the amount of remaining growth of a structure and the actual anatomical capability of the skeletal unit to adapt.

While it is premature to suggest that the results of this study may benefit the human population, it certainly provides an exciting building block upon which further exploration of the potential therapeutic effect of using BoNT/A to alter the stretch-reflex of the masseter and temporalis muscles in combination with bite jumping therapy can be made.

Potential Future Work

This study has provided a unique and novel insight into the effects of BoNT/A applied to selected muscles in growing animals under well-controlled conditions and the subsequent effects on craniofacial growth. However there are two main technologies available that would potentially improve a similar future study:

Micro-Computed Tomography (micro-CT)

Clearly there are limitations imposed by radiographs providing only two-dimensional information. Radiography does not allow for volume changes and bone density alteration measurements which could provide useful information of clinical relevance (Kwon et al., 2007, Matic et al., 2007). Unfortunately, an *in vivo* micro-computed tomography imager was not available within the research facility at the time of data collection and would be of benefit for future studies.

Guided Injection technique

Traditionally, especially in the cosmetic industry, clinicians have placed injections based on observation of muscle activity and palpation. It has been shown that in larger muscles, needle placement is accurate from 46-78% of the time, however in smaller muscles this accuracy is significantly decreased (18-37%) (Ramachandran and Eastwood, 2006). Electrical stimulation guided injection involves using an electrode needle and an electromyographic (EMG) unit which amplifies electric potential signals from the motor endplate of the muscle. As the facial anatomy does vary between individuals it has been reported that EMG more accurately identifies the pattern of muscle activity (Klein and Mantell, 1998). However more research is required to ascertain whether this leads to enhanced clinical results. Additionally, although theoretically the ideal injection point would target the end-plate area of a muscle, there is little evidence to support this theory (Ramachandran and Eastwood, 2006). Other injection guiding techniques have included ultrasound, fluoroscopy and CT (Ramachandran and Eastwood, 2006) and are worth investigating for future work. Compensatory increased muscle activity in other jaw closer muscles has been reported after BoNT/A injections in the medial pterygoid and cannot be ruled out with respect to reducing experimental effects (Rafferty et al., 2012). Guided technique would be of assistance in targeting the deeper medial pterygoid in future work.

Future Work Relating to the Current Study

The study has focused on the growth changes as identified through measurement of standardized lateral and dorsoventral radiographs. Although other material was collected from the same animals, this was impossible to include within the present thesis through a combination of logistical problems and time constraints. Nevertheless, this material could be used in future to further investigate the effects of BoNT/A on specific structures. Bilateral masseter and temporalis muscles and a condyle were harvested from the short-term groups

(49 days of age) and from the long-term groups (126 days of age) and archived in RNA Later®. The remaining condyle was also stored for future imaging. Both the muscle and condyle samples were stored at minus 80 degrees Celsius. Further aims with respect to this collected data include:

Effects on the Masseter and Temporalis Muscle structure

1. To examine the short-term and long-term genotype changes to skeletal muscle fibre types after bite-jumping appliance therapy and/or BoNT/A injections to the temporalis and deep masseter muscles in the rodent model via Real Time PCR gene expression analysis.

2. To examine the short-term and long-term phenotype changes to skeletal muscle fibre types after bite-jumping appliance therapy and/or BoNT/A injections to the temporalis and deep masseter muscles in the rodent model via protein assay analysis.

Three Dimensional Measurements of the Mandibular Condyles

3. To examine the short-term and long-term volumetric changes to the mandibular condyle and condylar cartilage after bite-jumping appliance therapy and/or BoNT/A injections to the temporalis and deep masseter muscles in the rodent model using micro-CT imaging.

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9 APPENDICES

9.1 Appendix 1: Pilot Work and Preliminary Studies

The University of Queensland Doctorate of Clinical Dentistry (Orthodontics) Thesis

'Releasing the mandibular neuromuscular envelope with botulinum toxin type A (BoNT/A)'

Daniels, SJ. Dudhia, MR. Richardson, A. Kravchuk, O. Ho, C. Meunier, FA. Freer, TJ.

The Pilot Study - Developing the Rodent Model
Abstract

Background: The muscles of mastication have been identified as an extrinsic influence on craniofacial skeletal morphology. However, the dominance of intrinsic versus extrinsic skeletal morphological control is uncertain. Within the literature there exists a vast array of animal models making it difficult to extract consistent answers. Botulinum neurotoxin type A (BoNT/A) is a non-surgical research tool which selectively induces transient muscle paralysis.

Aims: The purpose of this study was to develop a reliable experimental model to examine the effect of BoNT/A induced paralysis of the muscles of mastication on craniofacial growth. The specific aims were to determine the effect of unilateral injections of BoNT/A on the vibrissal, temporalis, and masseter muscles, and to elucidate the maximum effective dose of BoNT/A per injection site, and the onset and duration of muscle paralysis.

Methods: Twenty-seven inbred juvenile male Wistar Kyoto (WKY) rats were randomly assigned to five groups: Control (n=6); Dissection (n=3); and dose-response groups: DR6 (n=6); DR4 (n=6), and DR2 (n=6). BoNT/A (Dysport® 500 Units (U) per vial diluted with 2.5 mL of saline) was injected at doses of 6 U (Group DR6), 4 U (Group DR4), and 2 U (Group DR2) per muscle. The right-hand side (RHS) temporalis, deep masseter, and vibrissae muscles were injected. The contralateral muscles were injected with similar amounts of saline.

Results: The maximum effective dose of BoNT/A was determined to be 4 U per injection site. The onset (11.25 to 13.29 hours) and duration (7.45 to 15.58 days) of BoNT/A induced paralysis in the vibrissa muscle was dose-dependent. Animals in the DR6 group displayed symptoms of flaccid paralysis indicating the dose and/or volume of the 6 U injection was high enough to induce systemic botulism. Animals in the DR4 and DR2 group showed reduced weight gain compared to control animals due to reduced masticatory efficiency.

Conclusions: The doses of 4 U and 2 U of BoNT/A can induce total vibrissae paralysis for up to one week. Repeat BoNT/A injections will be necessary to maintain paralysis for longer periods. The timing of paralysis onset and duration were faster and shorter respectively, than times observed in humans. BoNT/A is a complex research tool and further understanding of toxin function and effect is needed. The juvenile WKY rodent model may be useful in future craniofacial growth studies.

9.2 Appendix 2: Animal Ethics Certificate

THE UNIVERSITY OF QUEENSLAND

PLEASE KEEP THIS FORM IT IS YOUR RECORD OF YOUR AEC APPROVAL NUMBER

Ms Ann Higgins
Animal Welfare Coordinator
Research and Research Training Division
Cumbrae Stewart Building (72)
St Lucia Q 4072
Ph: (07) 3365 2713 Fax: (07) 3365 4455
Email: a.higgins@research.uq.edu.au

ANIMAL ETHICS APPROVAL CERTIFICATE Date: 19-Sep-2008

Dear Dr Frederic Meunier

The following project: *Releasing the mandibular neuromuscular envelope with botulinum neurotxin type A (BTX-A): skeletal, dental and muscular effects*

Requesting funding from (Grant Awarding Body):- Australian Dental Research Foundation involves animal experimentation. It has been reviewed and ethical clearance obtained from the University Animal Ethics Committee (Health Sciences).

AEC Approval Number: SBMS/QBI/829/08/ADRF

Previous AEC Number: SBMS/QBI/686/07/ADRF

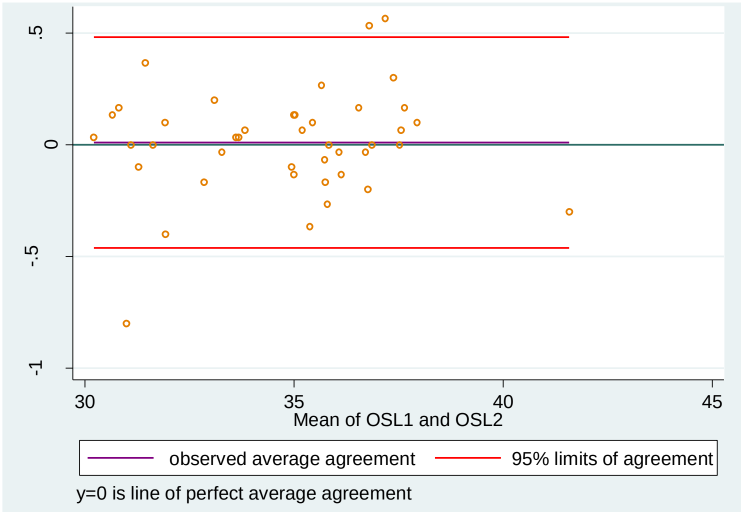
Approval Duration: 18-Sep-2008 to 18-Sep-2009

Permit(s):

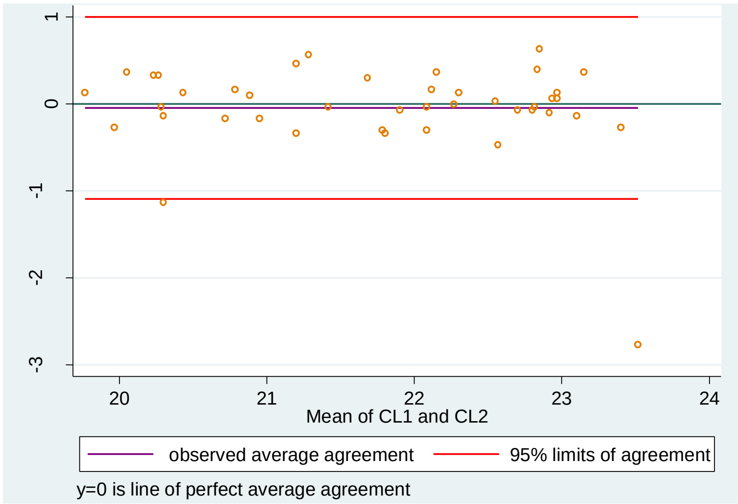
SUBSPECIES	STRAIN	CLASS	GENDER	SOURCE	AMOUNT
Rats - Outbred	Wistar-Kyoto	Juvenile/Weaners/Pouch animal	Mix	Institutional Breeding Colony	**160**

9.3 Appendix 3: Bland and Altman (BA) Diagrams

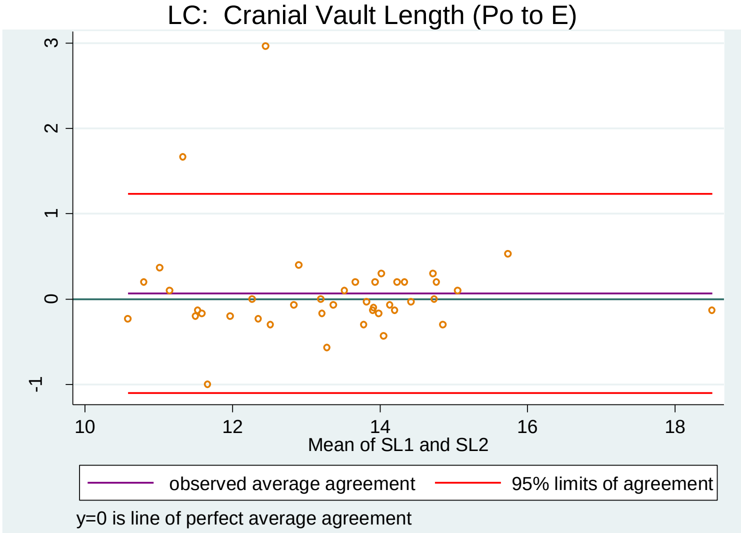
9.3.1 BA Diagrams for Lateral Cephalometric (LC) Repeatability Study



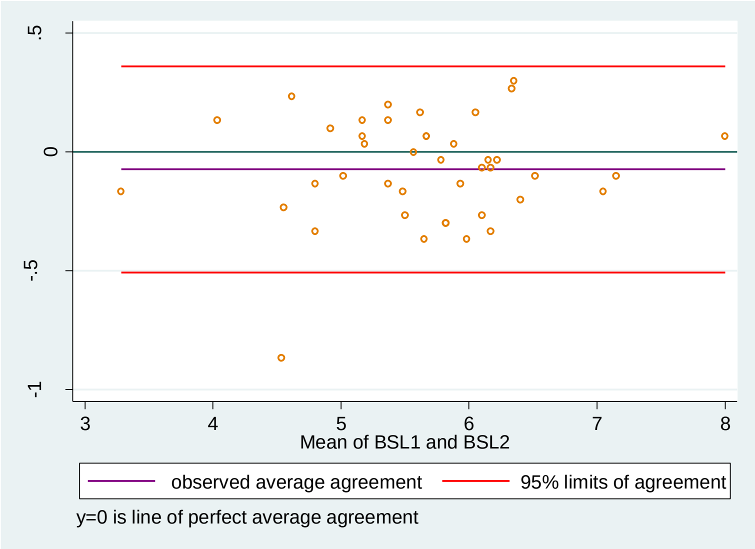
LC: Occipital to Snout Length (Po to N)



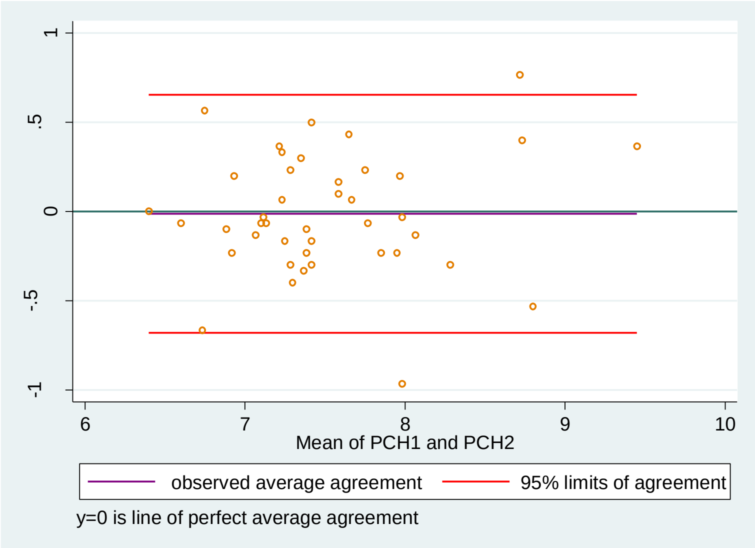
LC: Cranial Vault Length (Po to E)



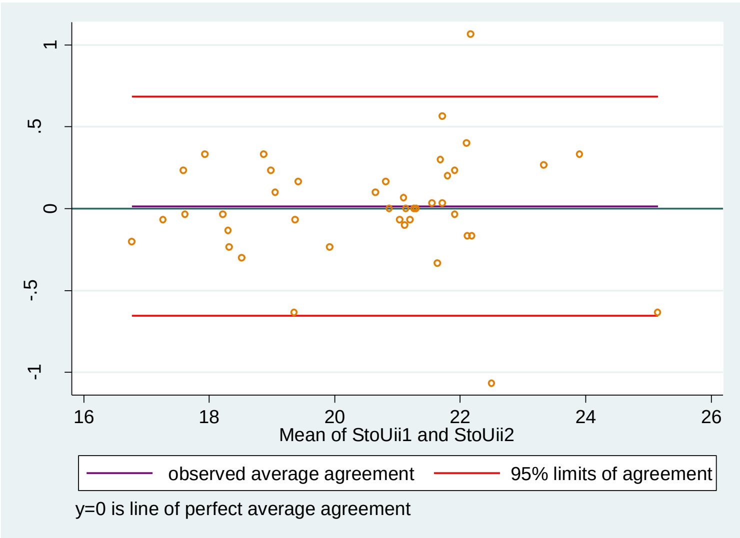
LC: Snout Length (E to N)



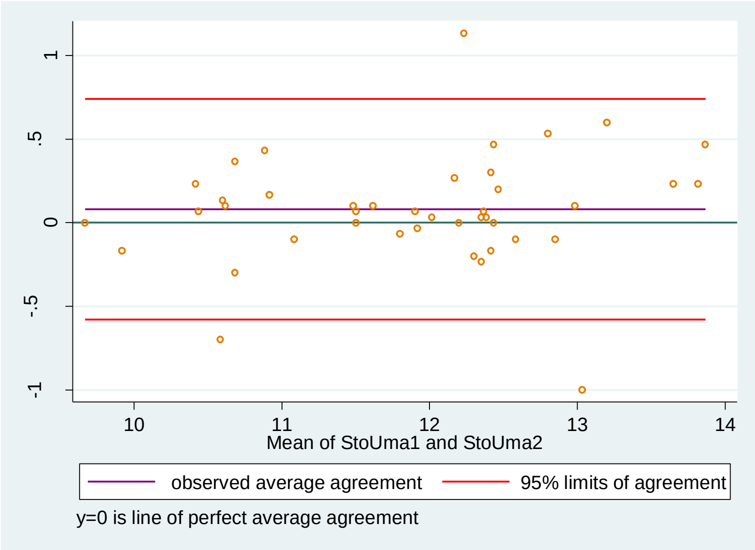
LC: Basispenoid Length (SOS to PBS)



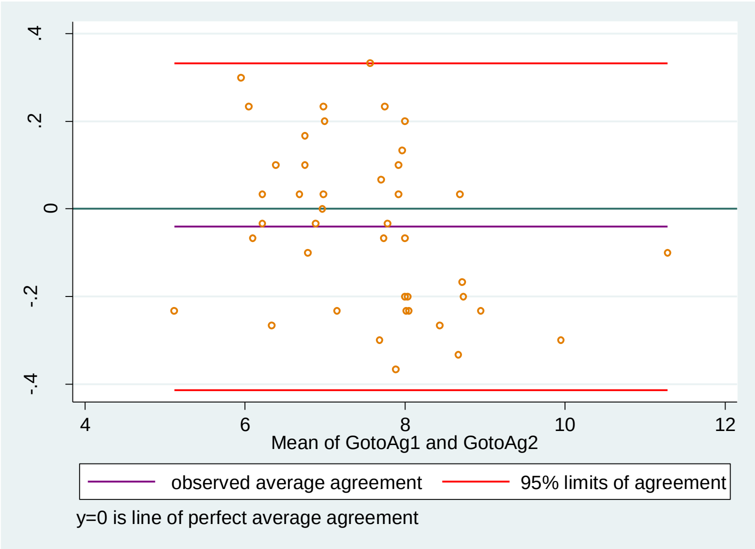
LC: Posterior Cranial Height



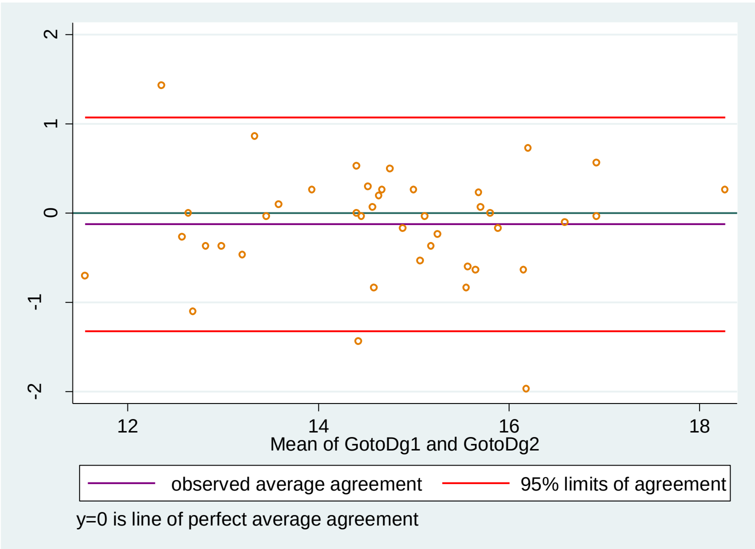
LC: S to Uii



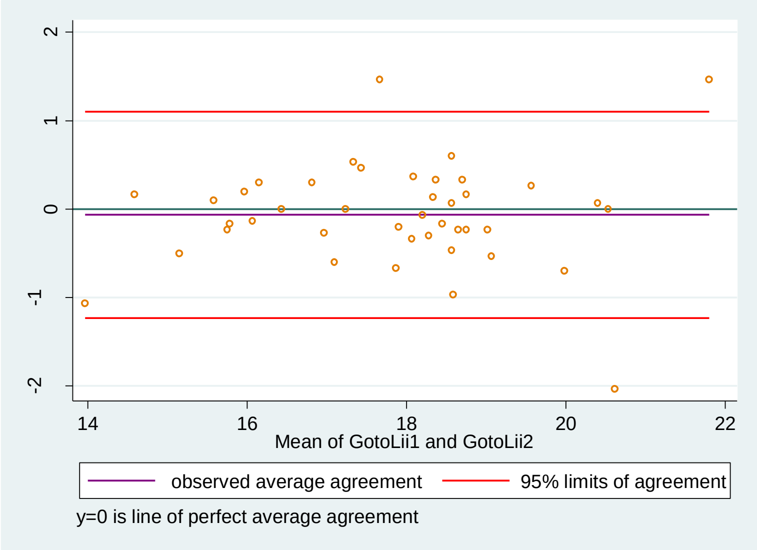
LC: S to Uma



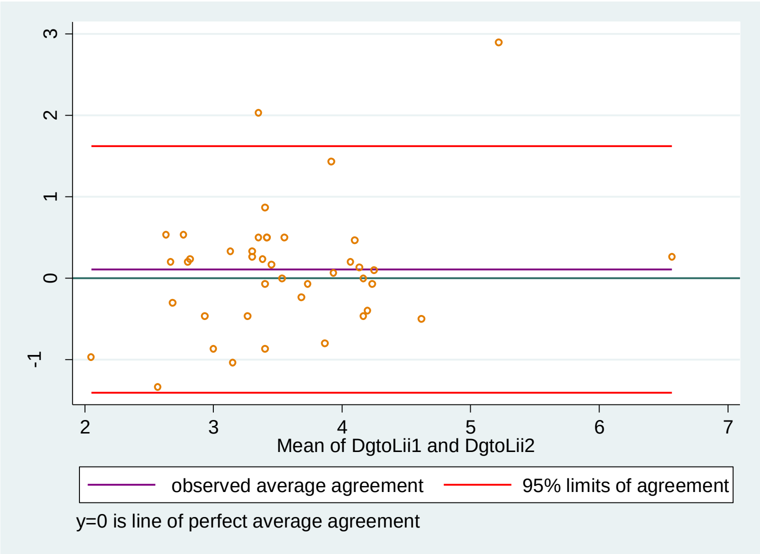
LC: Go to Ag



LC: Go to Dg



LC: Go to Lii



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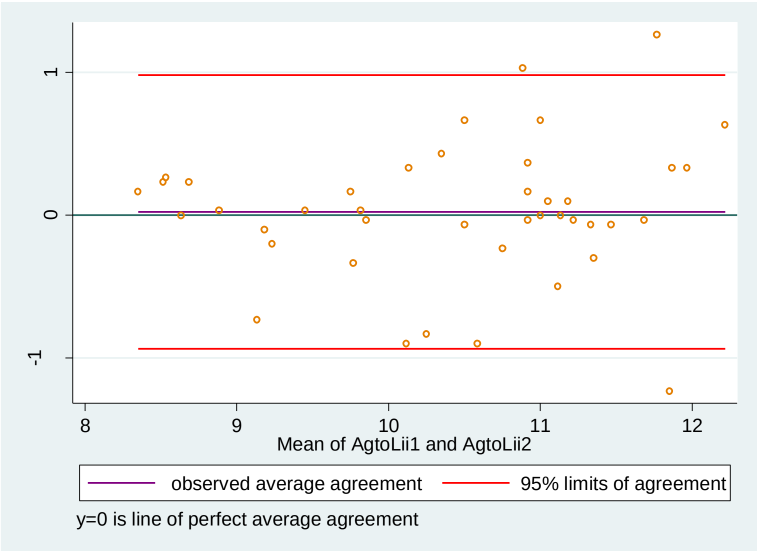
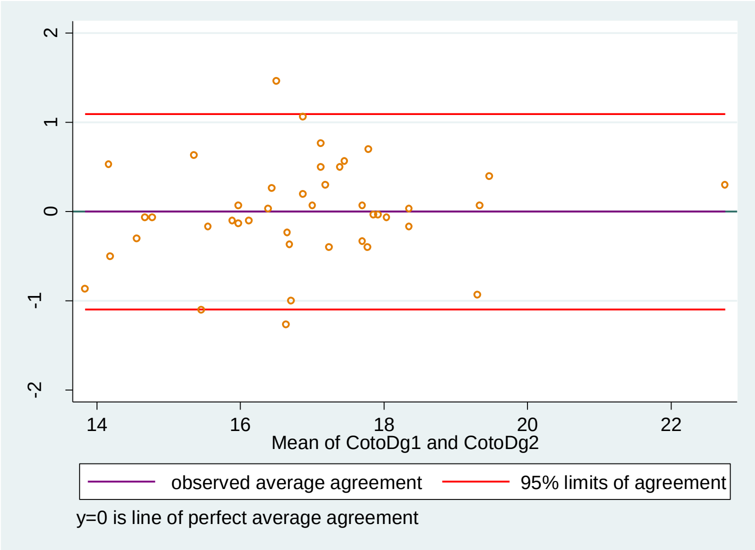
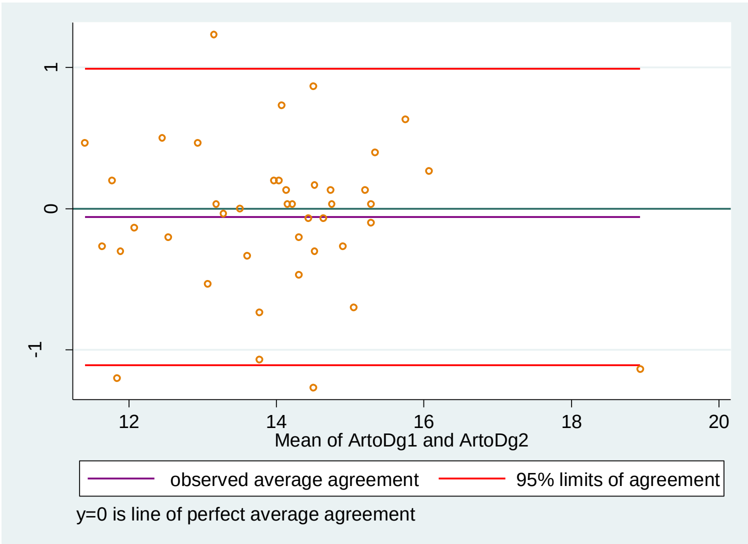


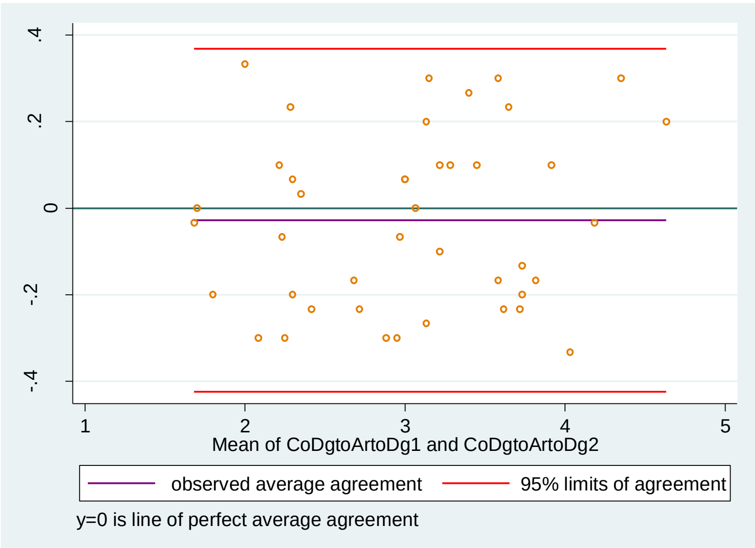
LC: Ag to Lii



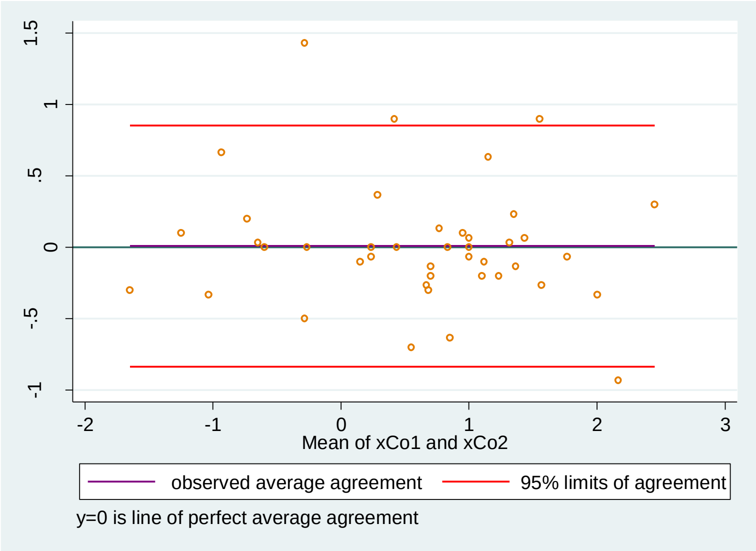
LC: Co to Dg



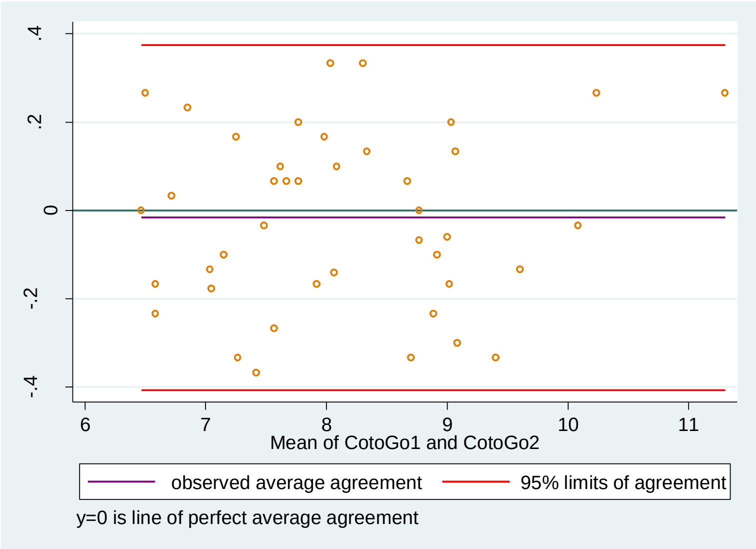
LC: Ar to Dg



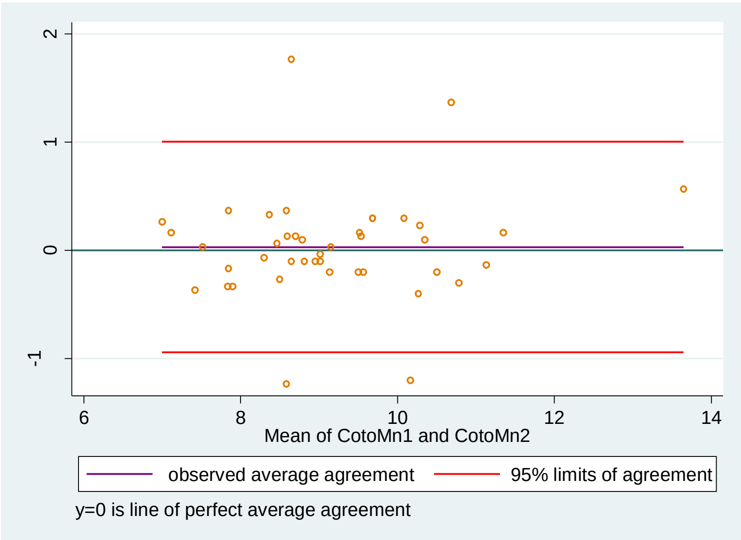
LC: (Co to Dg) – (Ar to Dg)



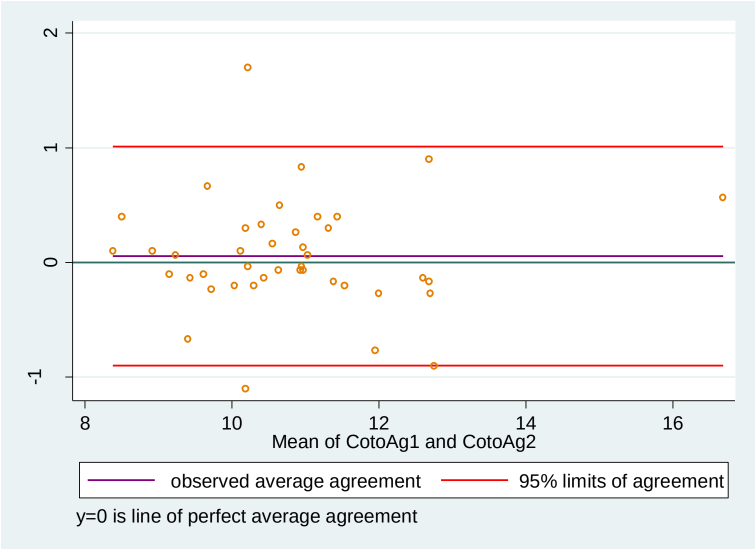
LC: Sagittal Projection of Condylion



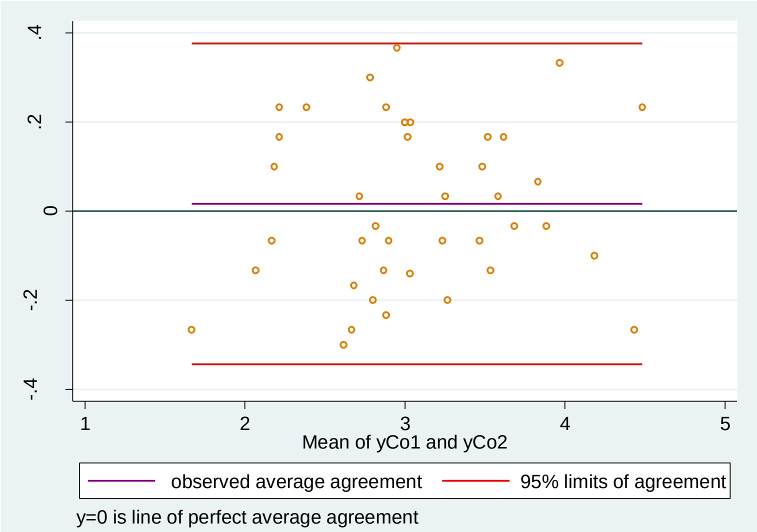
LC: Condylion to Gonion



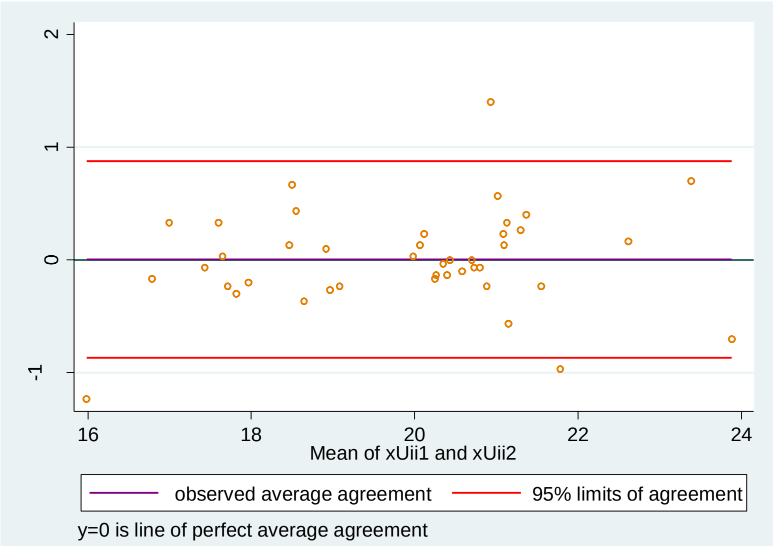
LC: Condylion to Mn



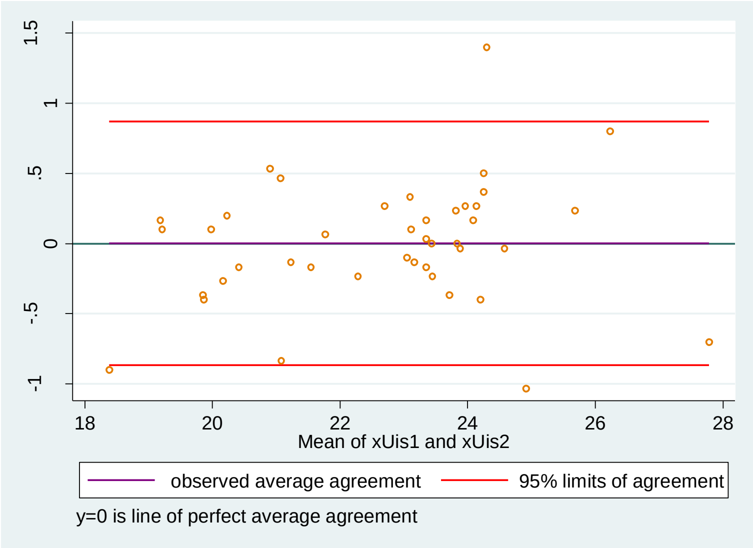
LC: Condylion toAg



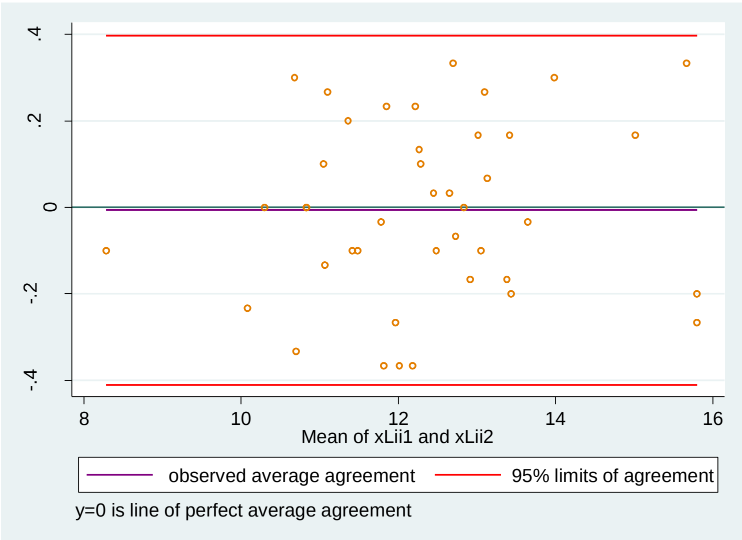
LC: Vertical Projection of Condylion



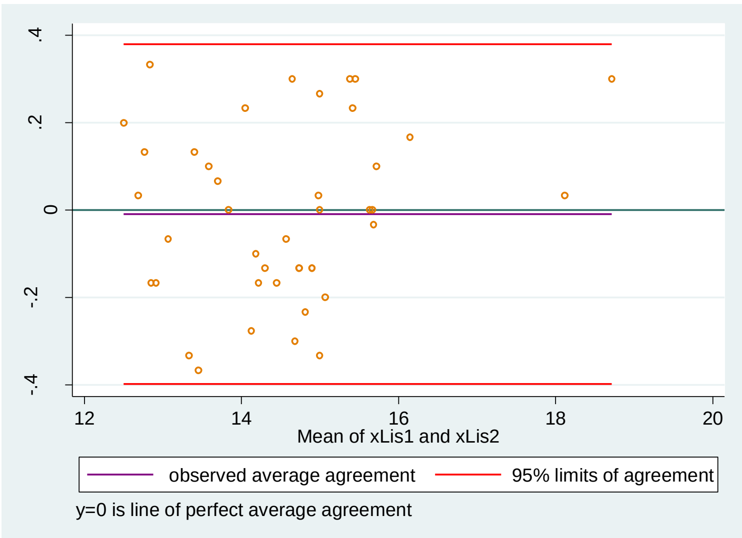
LC: Sagittal projection of xUii



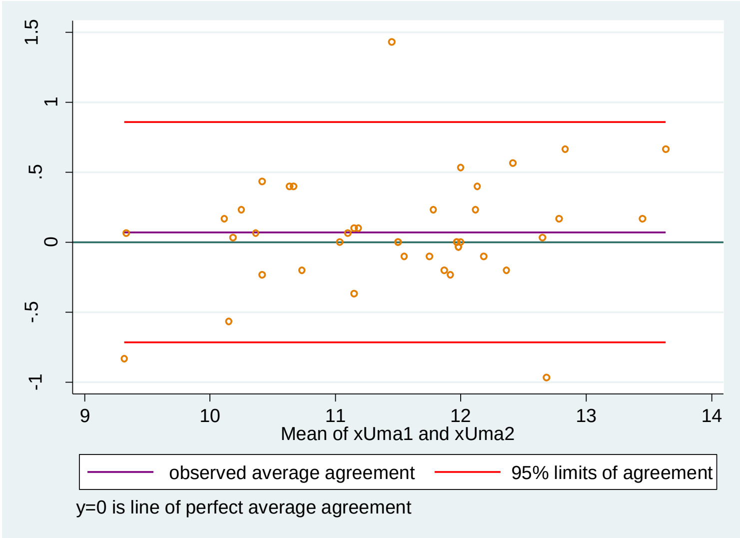
LC: Sagittal projection of xUis



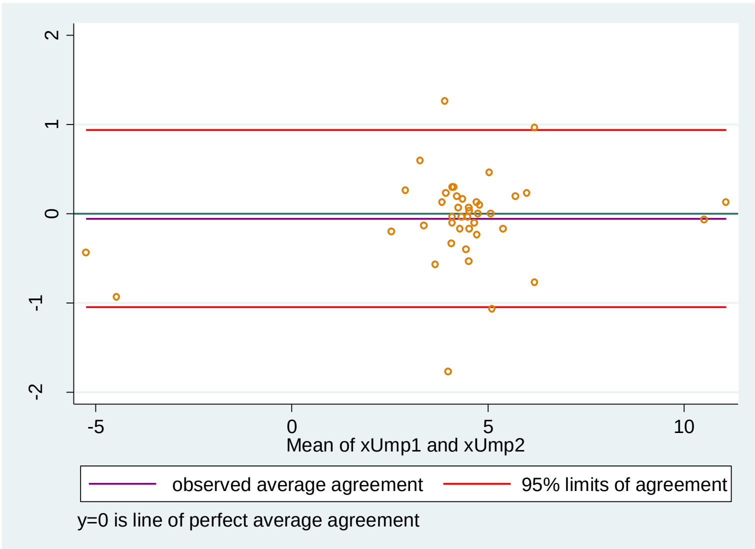
LC: Sagittal projection of xLii



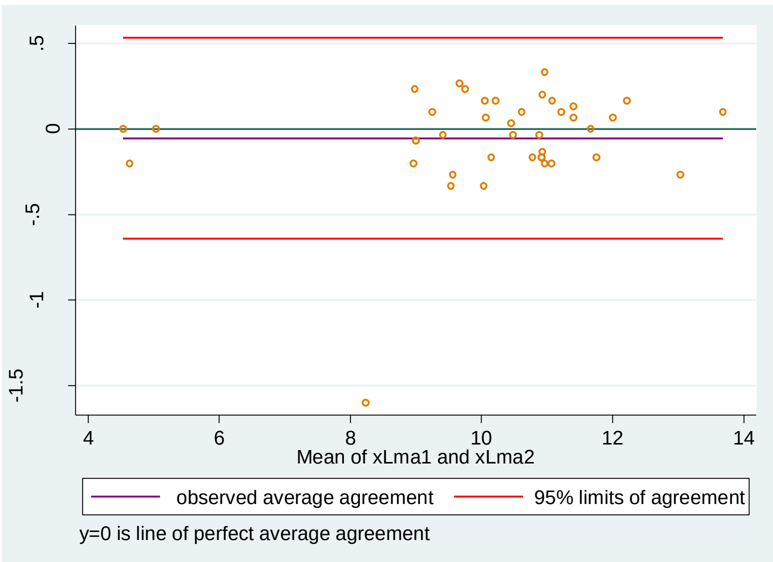
LC: Sagittal projection of xLis



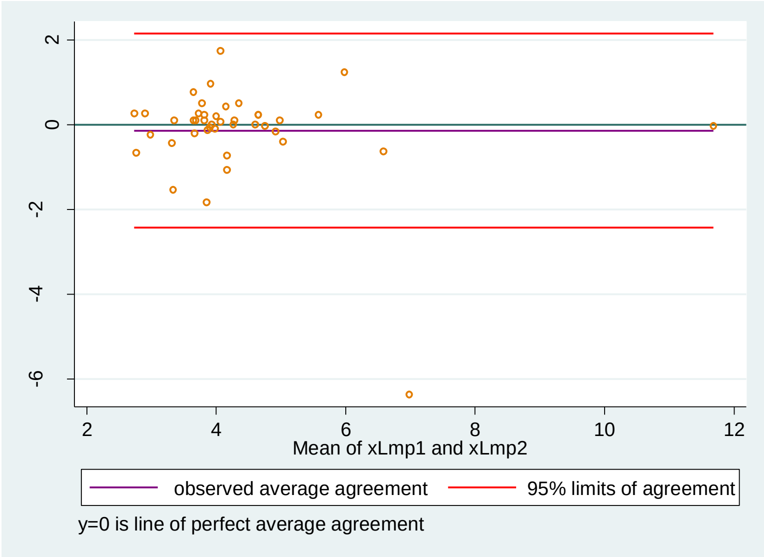
LC: Sagittal projection of the upper molar anterior



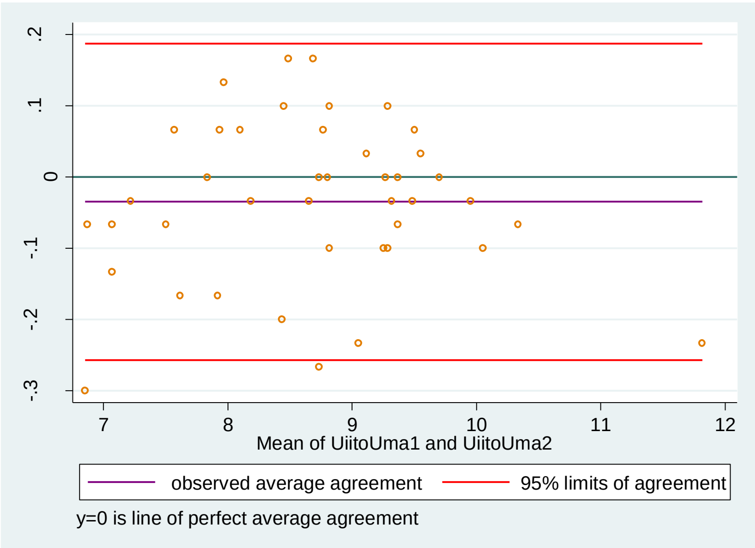
LC: Sagittal projection of the upper molar posterior



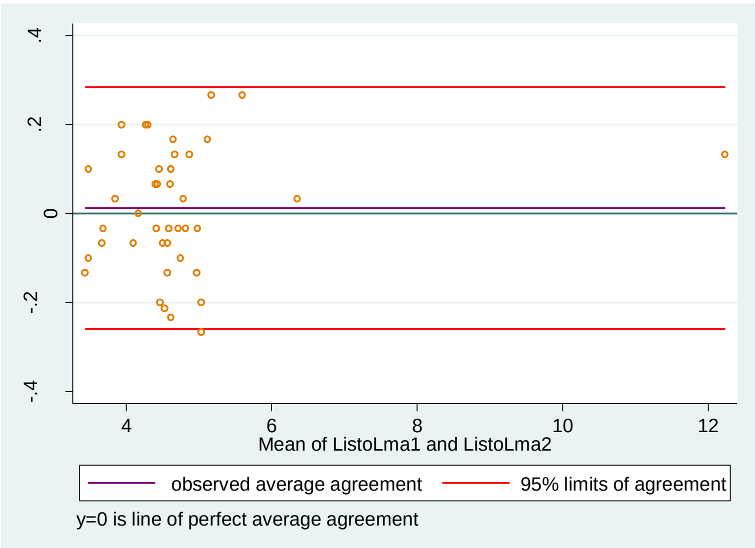
LC: Sagittal projection of the upper molar anterior



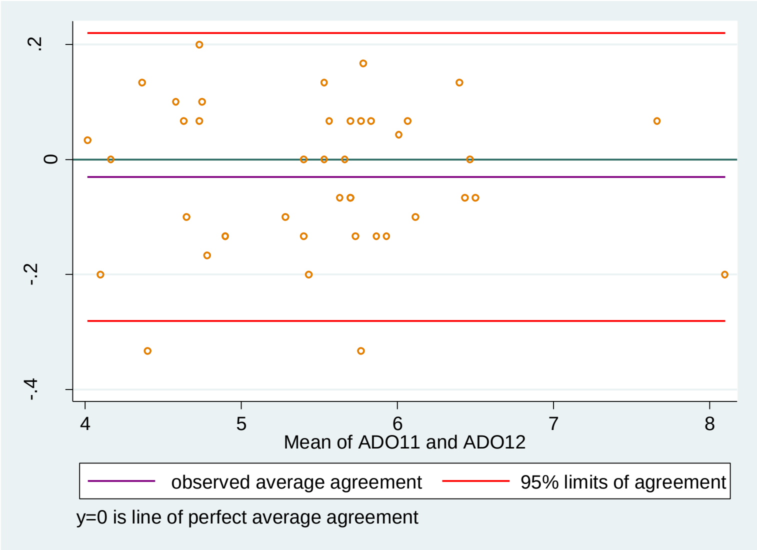
LC: Sagittal projection of the upper molar posterior



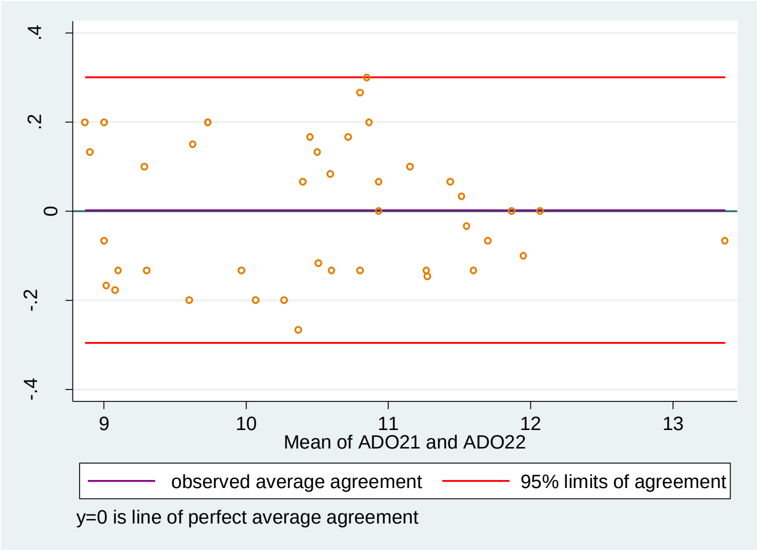
LC: Distance between upper molars and upper incisors



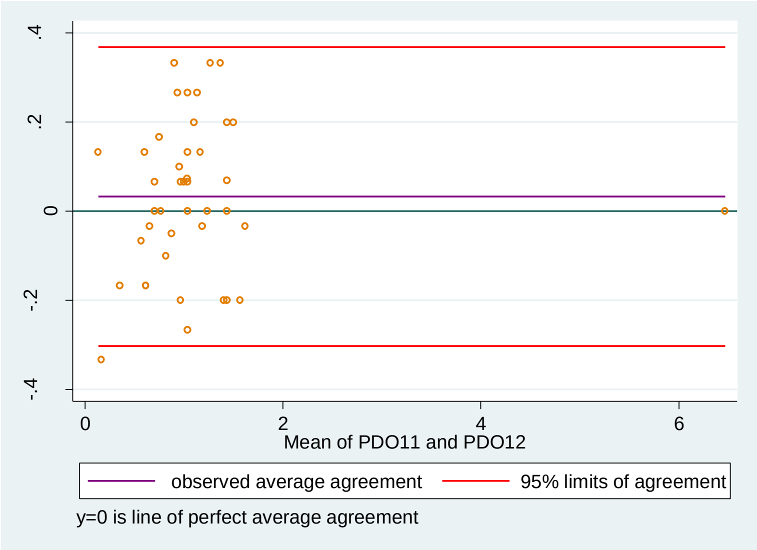
LC: Distance between lower molars and lower incisors



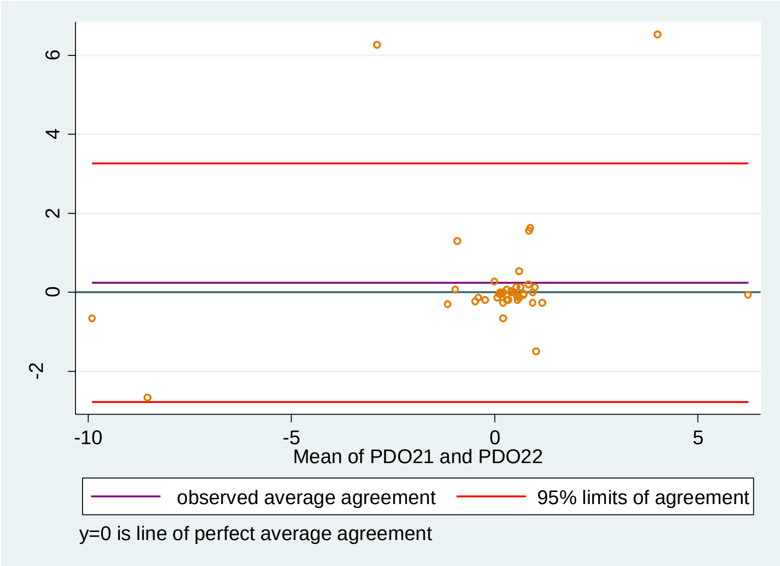
LC: ADO1 Anterior dentoalveolar overjet: (xUii – xLis)



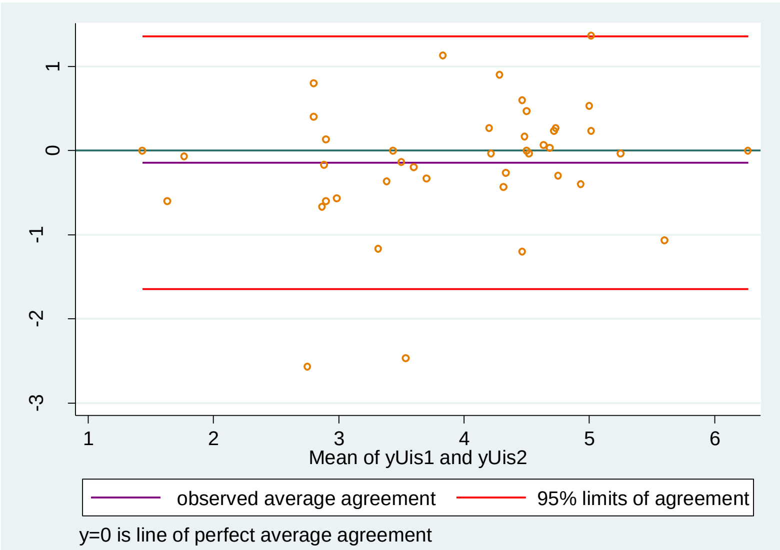
LC: Anterior dentoalveolar overjet: (xUis – xLii)



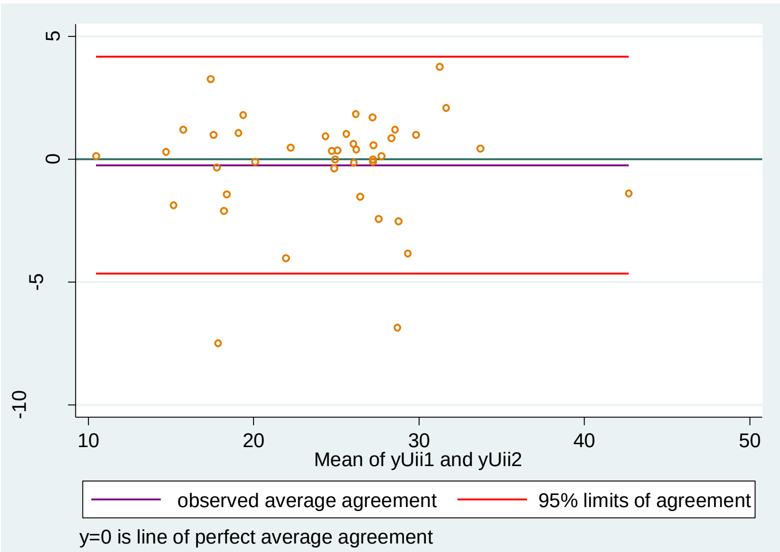
LC: Posterior dentoalveolar overjet: (xUma – xLma)



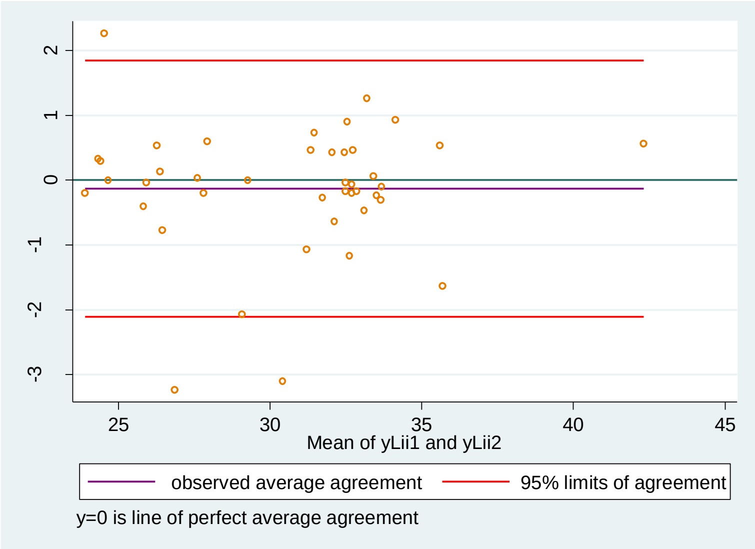
LC: Posterior dentoalveolar overjet (xUmp – xLmp)



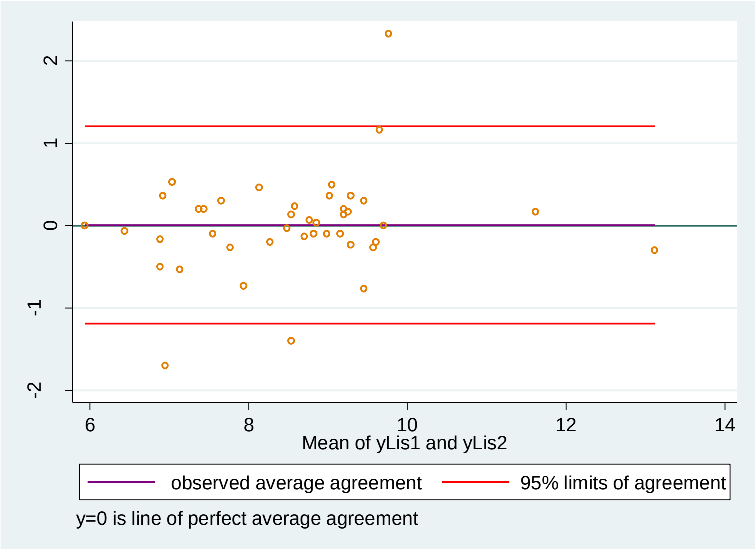
LC: Vertical projection of upper incisors yUis



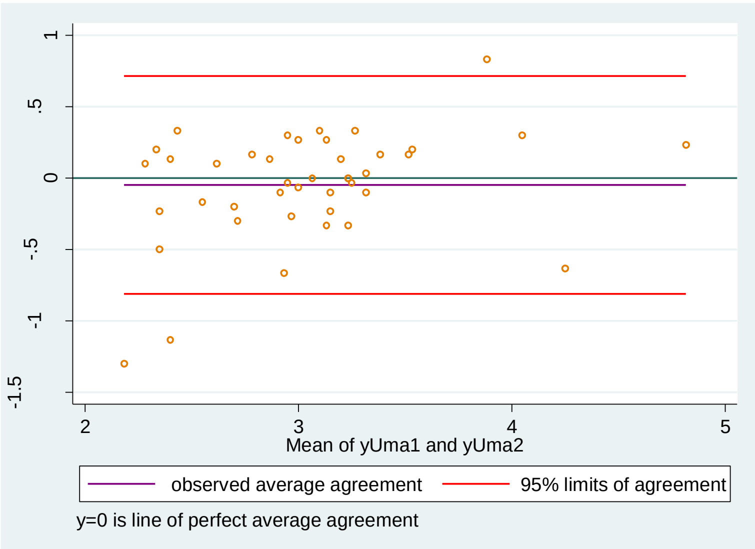
LC: Vertical projection of yUii



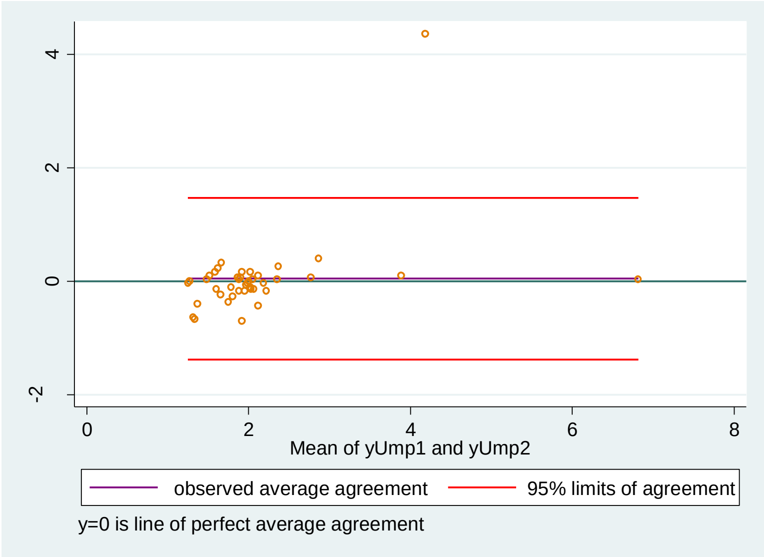
LC: Vertical projection of yLii



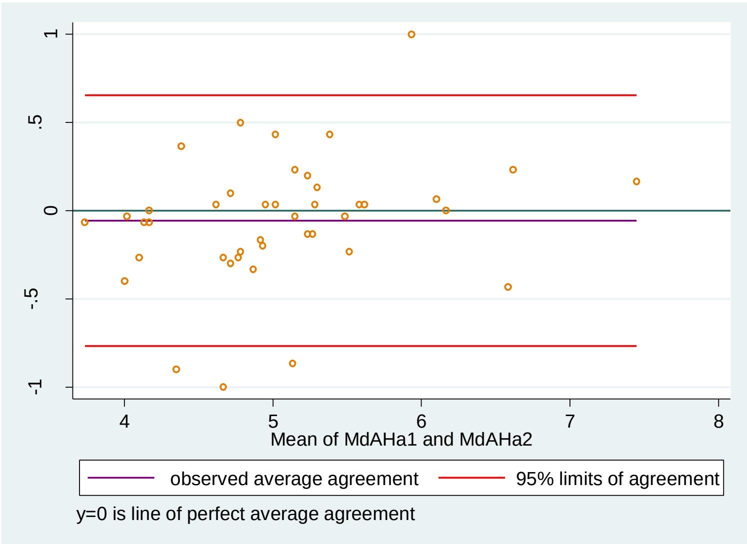
LC: Vertical projection of yLis



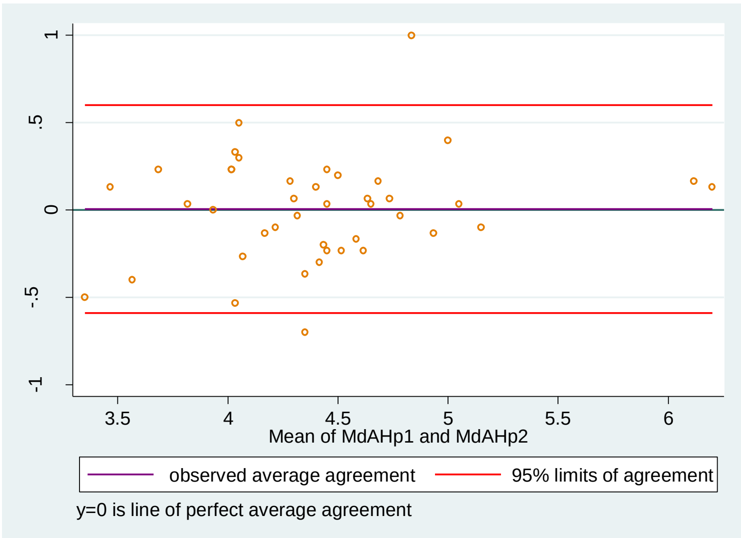
LC: Maxillary alveolar height at 1st molar (yUma)



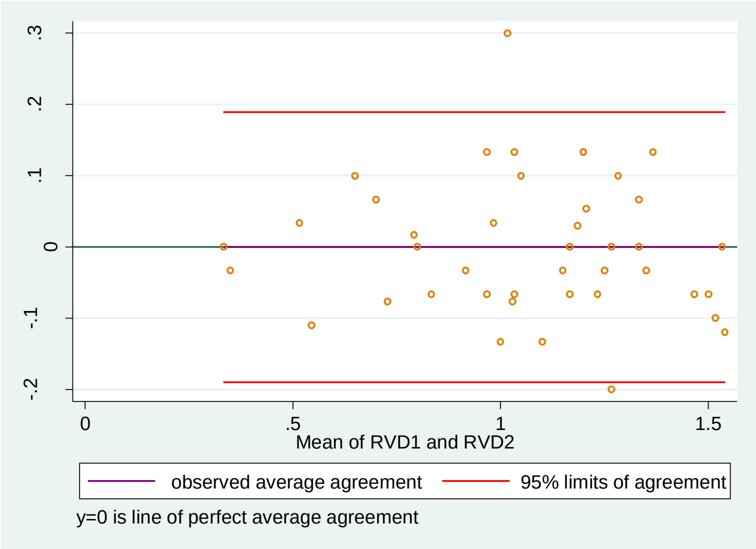
LC: Maxillary alveolar height at 3rd molar (yUmp)



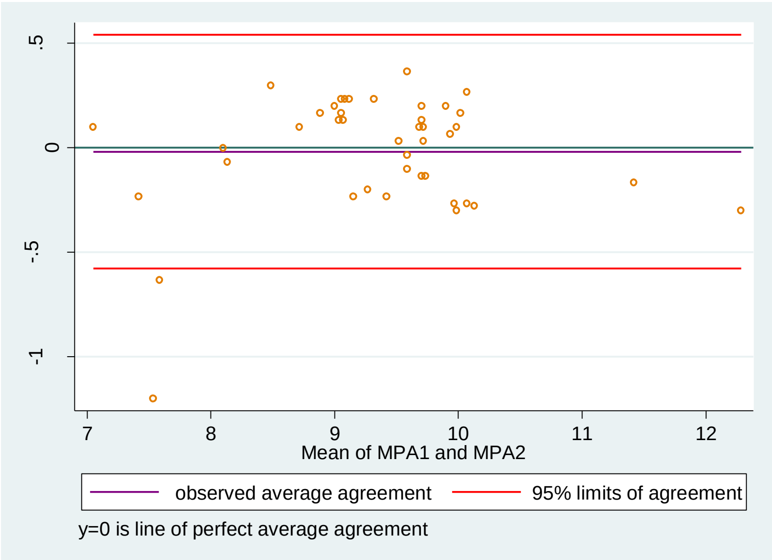
LC: Mandibular alveolar height at 1st molar (Dg to Lma)



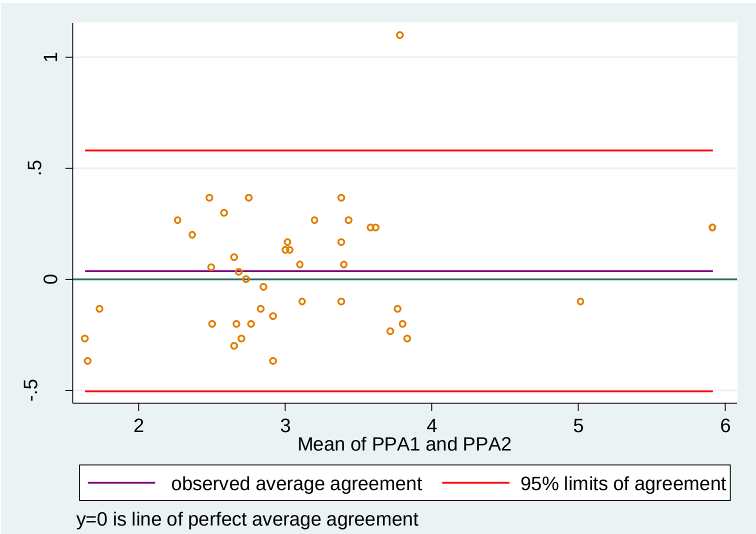
LC: Mandibular alveolar height at 3rd molar (Ag to Lmp)



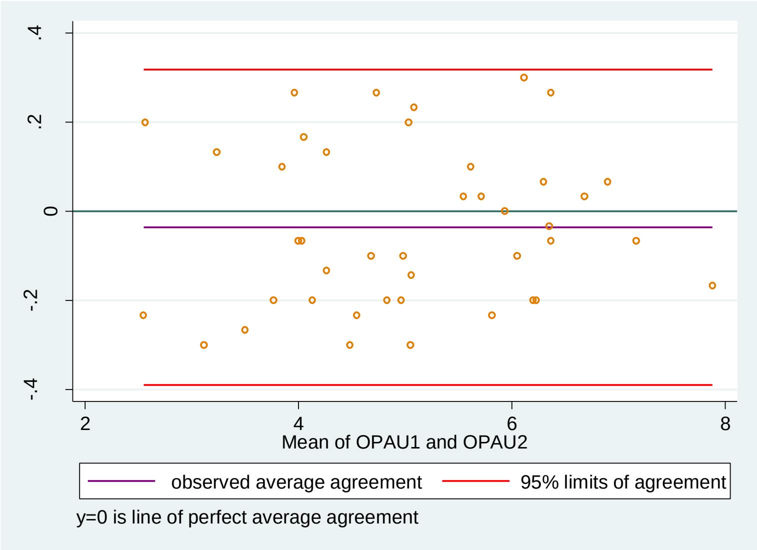
LC: Resting Vertical Dimension



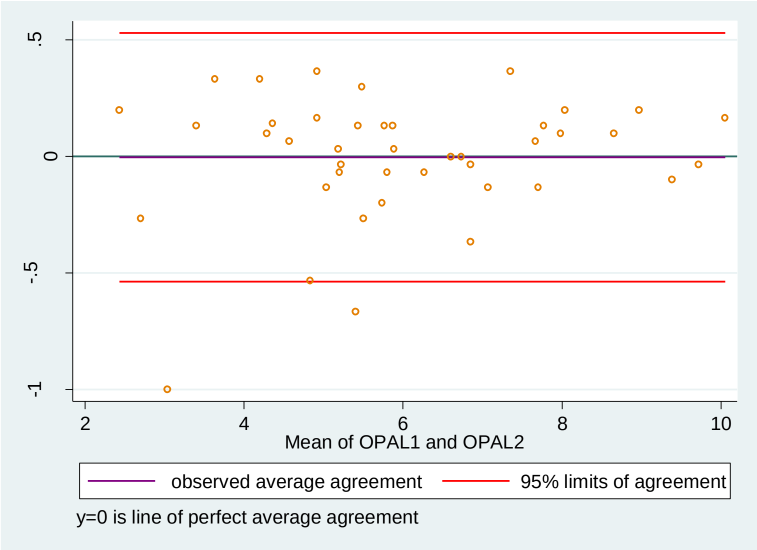
LC: Mandibular Plane Angle



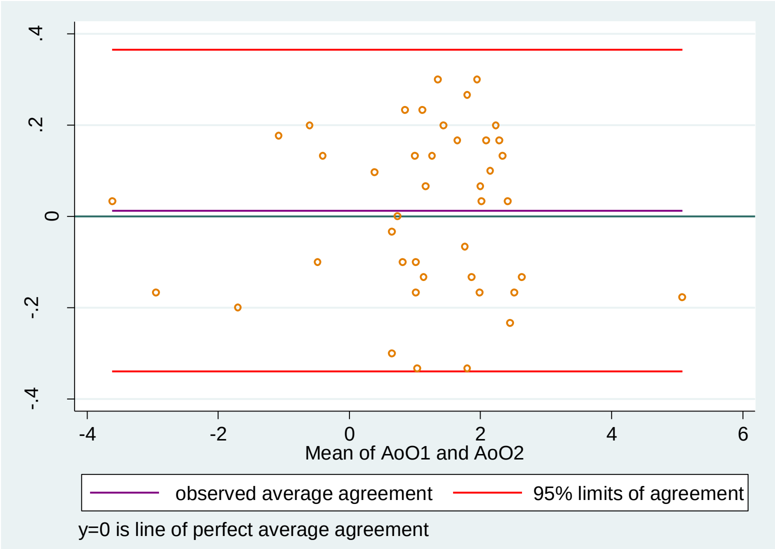
LC: Palatal Plane Angle



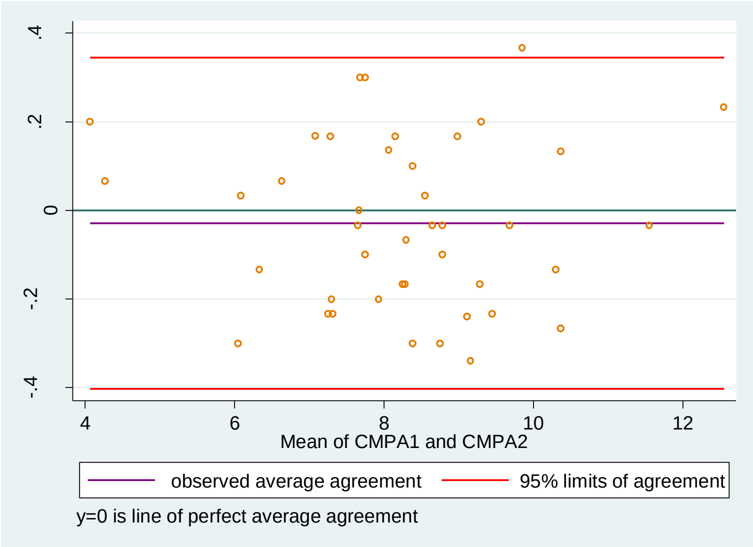
LC: OPA-U Angle between the cranial base and the occlusal plane upper



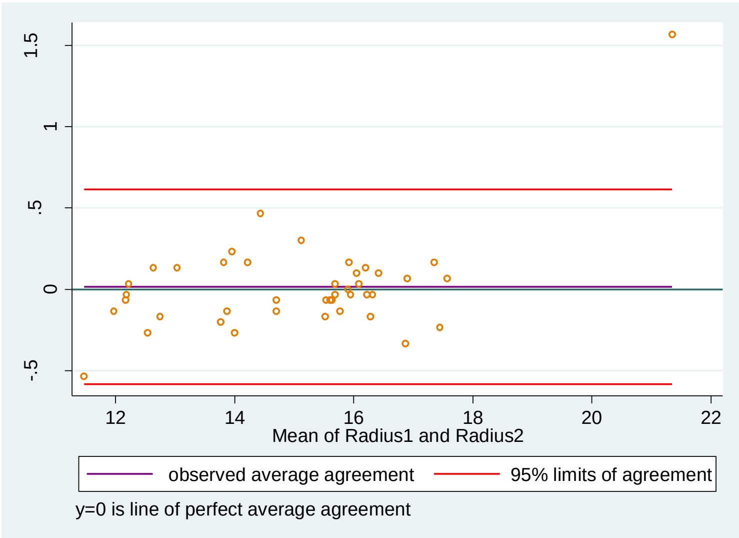
LC: OPA-L Angle between the cranial base and the occlusal plane lower



LC: Angle of opening (OPA-L – OPA-U)

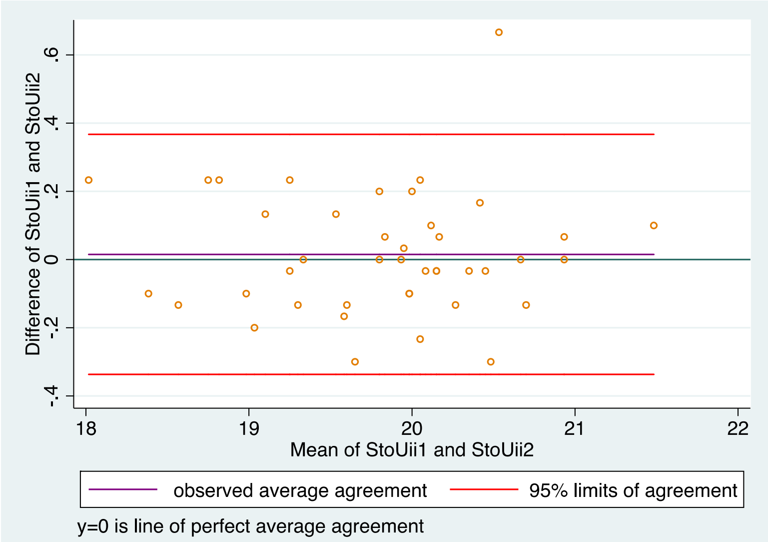


LC: Corrected Mandibular Plane Angle

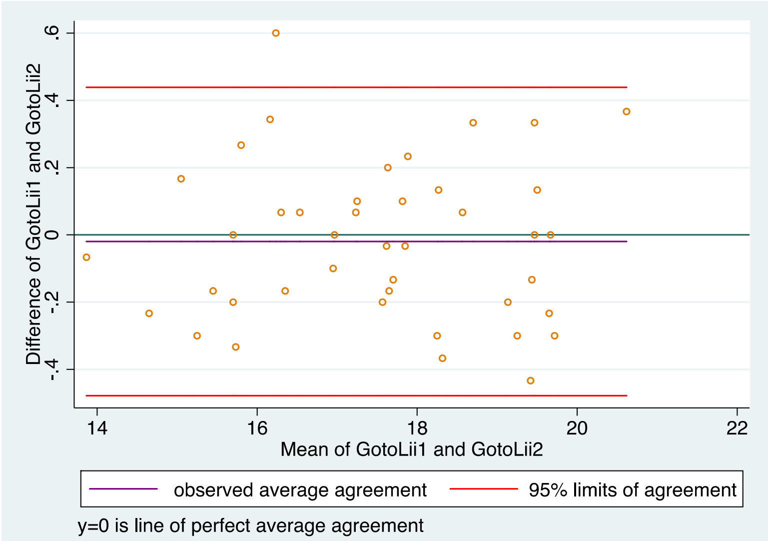


LC: Length of Radius

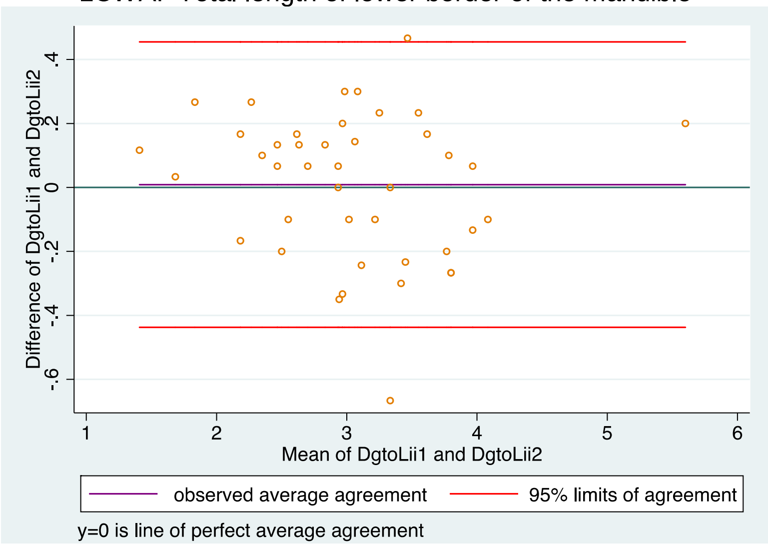
9.3.2 BA Diagrams for Lateral Cephalometric With Appliances (LCWA) Repeatability Study



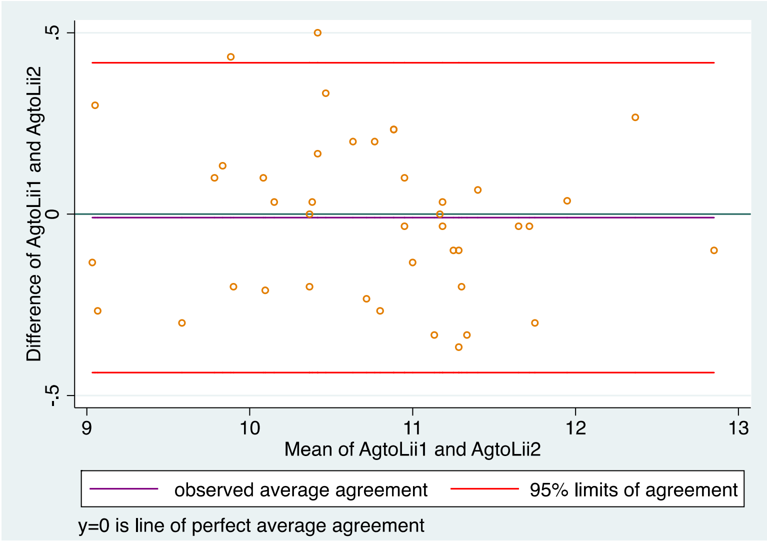
LCWA: Maxillary Length



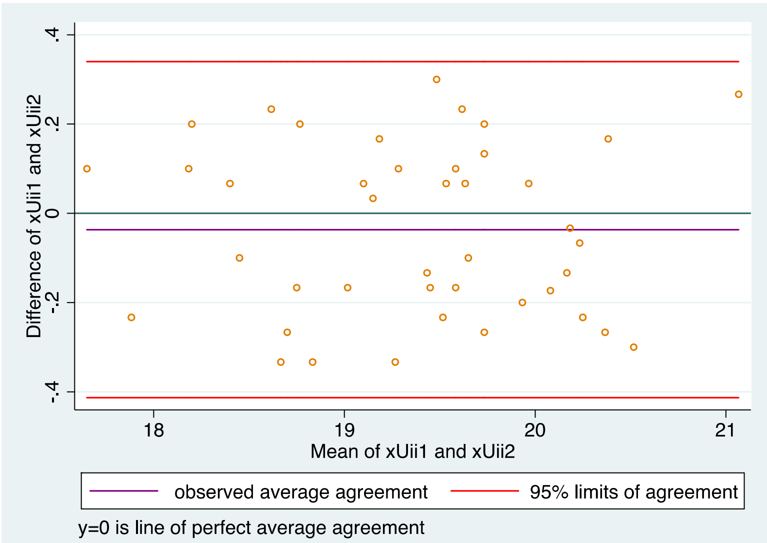
LCWA: Total length of lower border of the mandible



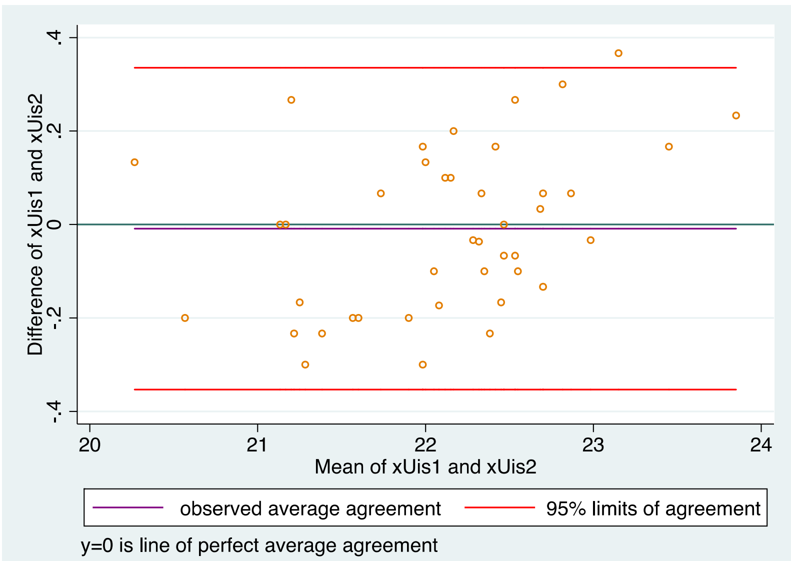
LCWA: Dg to Lii



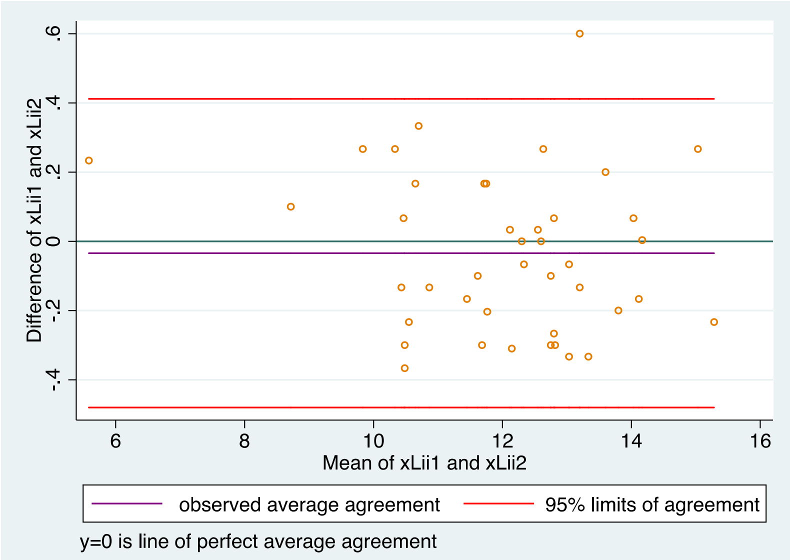
LCWA: Ag to Lii



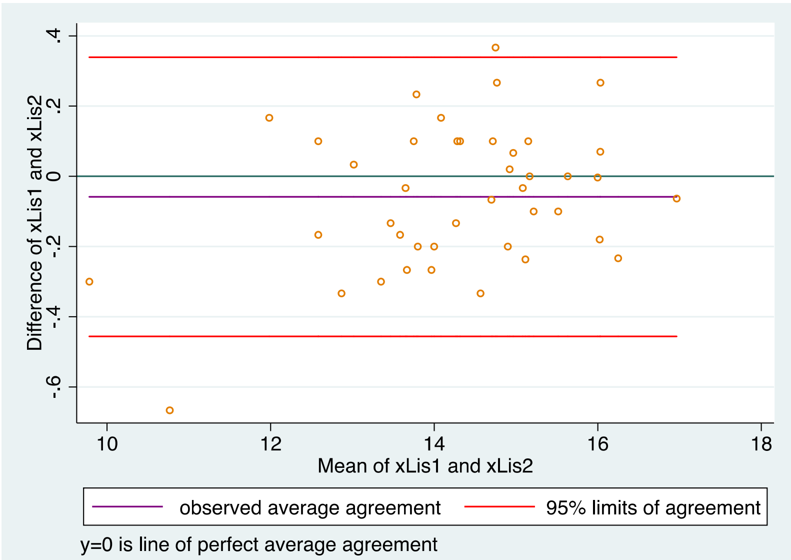
LCWA: xUii



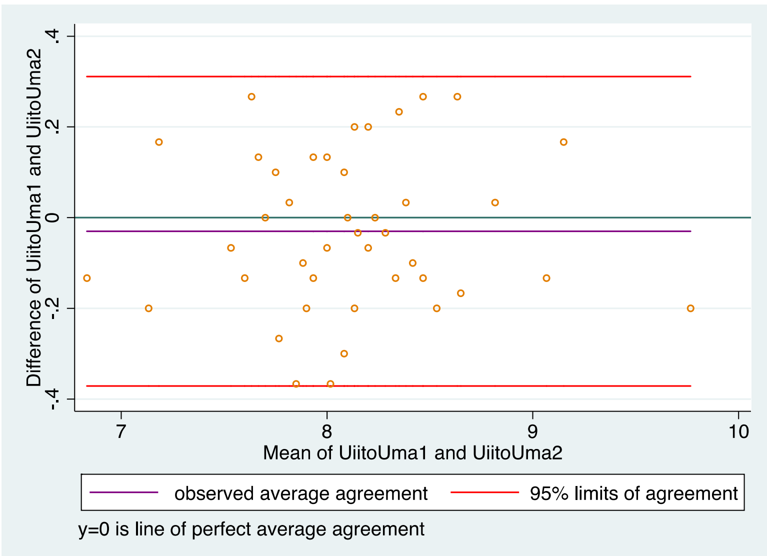
LCWA: xUis



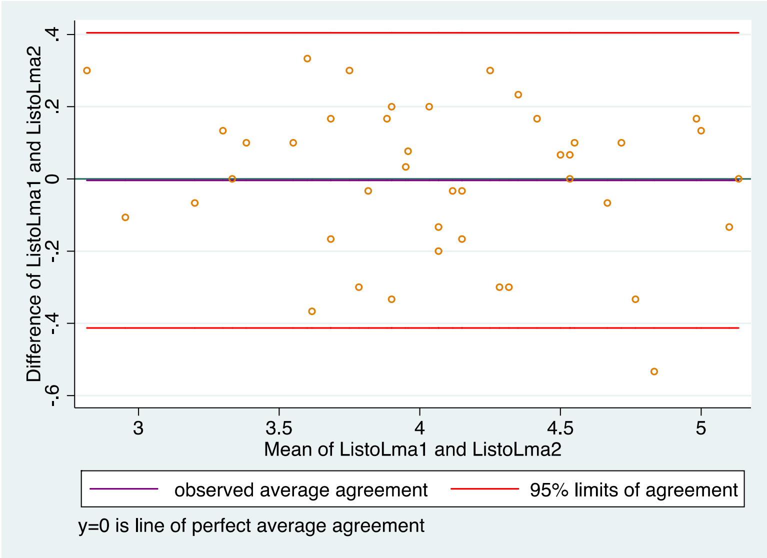
LCWA: xLii



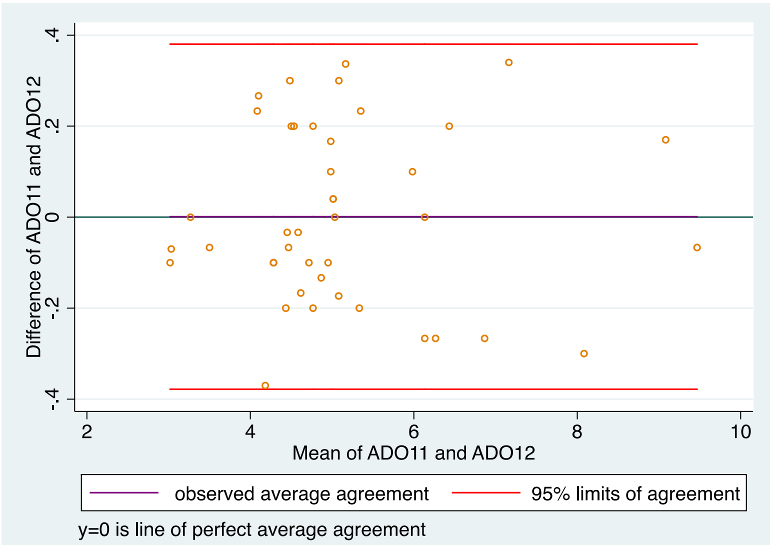
LCWA: xLis



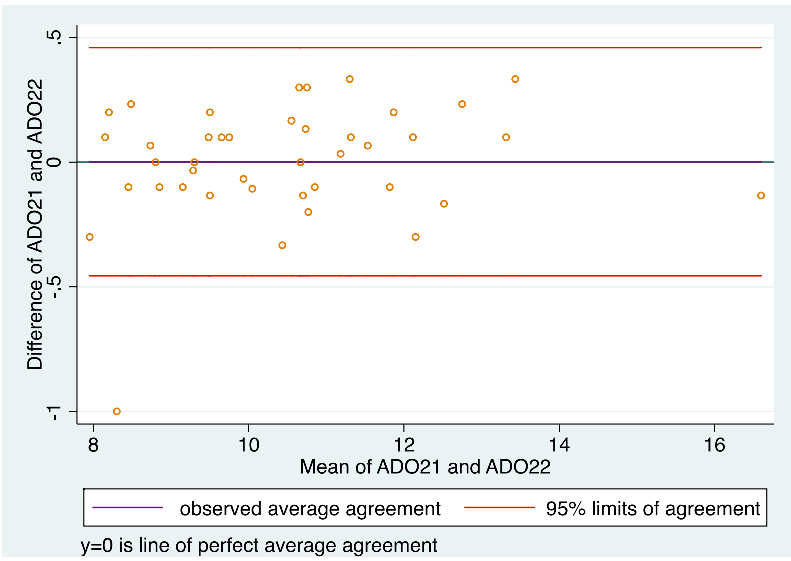
LCWA: Uii to Uma



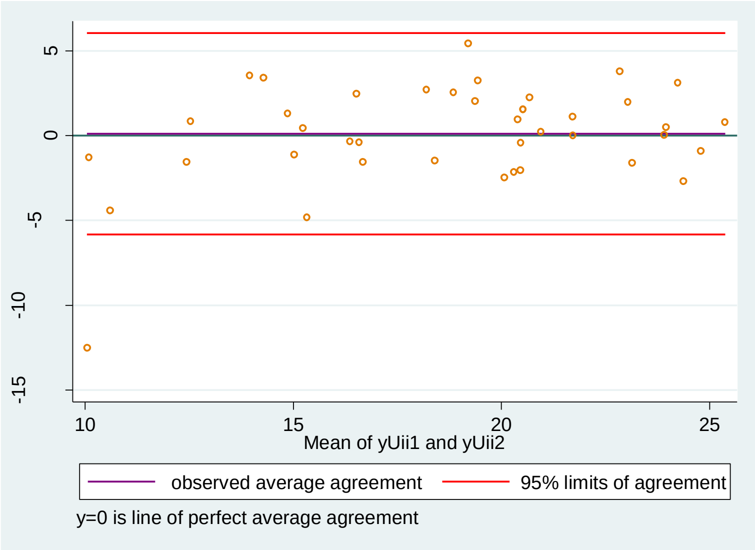
LCWA: Lis to Lma



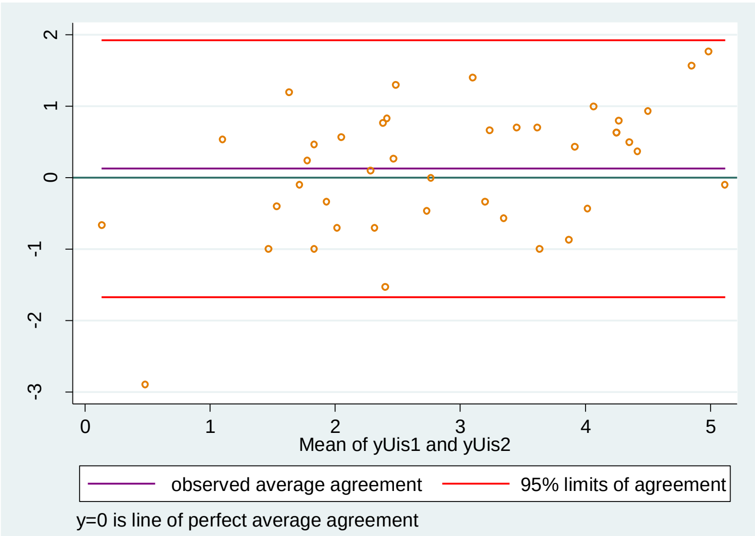
LCWA: ADO1



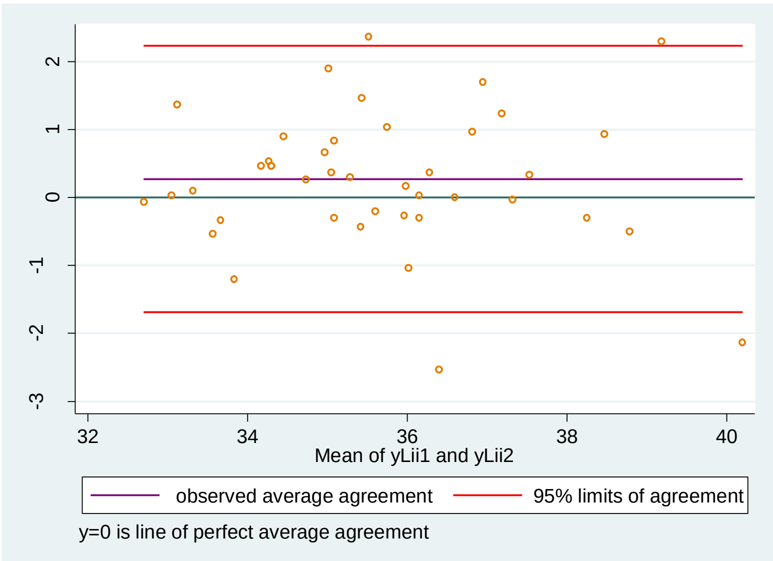
LCWA: ADO2



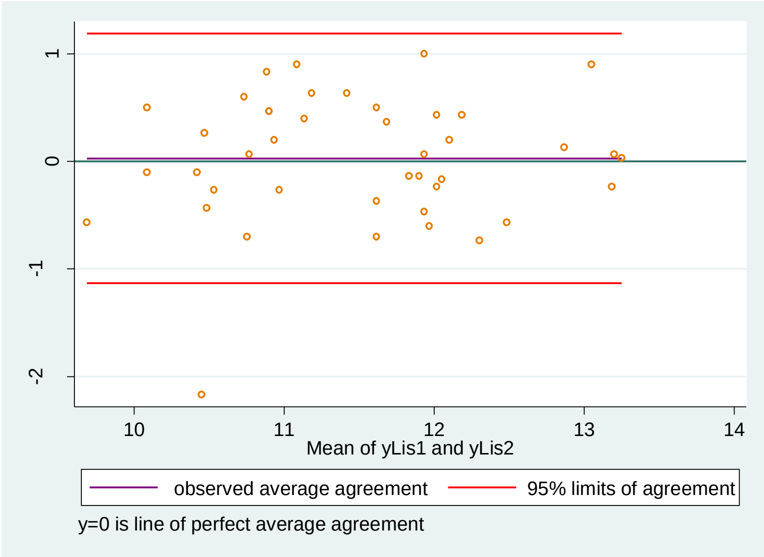
LCWA: yUii



LCWA: yUis



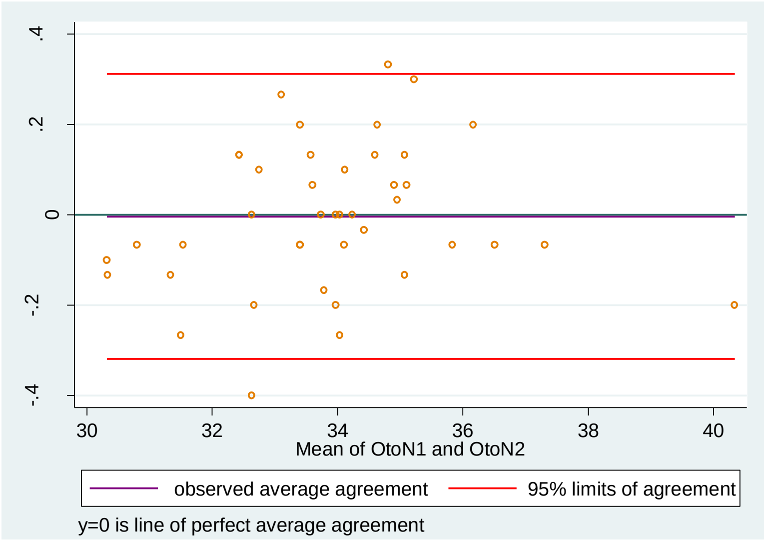
LCWA: yLii



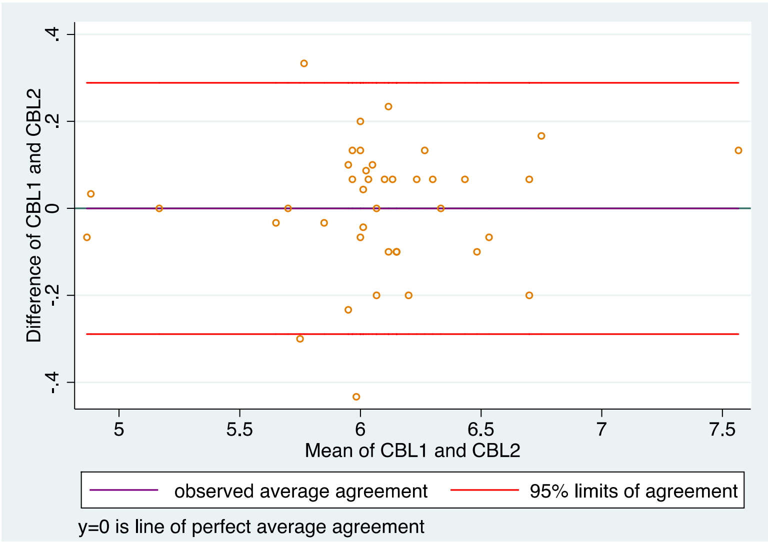
1
0
-1
-2
10
11
12
13
14
Mean of yLis1 and yLis2
observed average agreement
95% limits of agreement
y=0 is line of perfect average agreement

LCWA: yLis

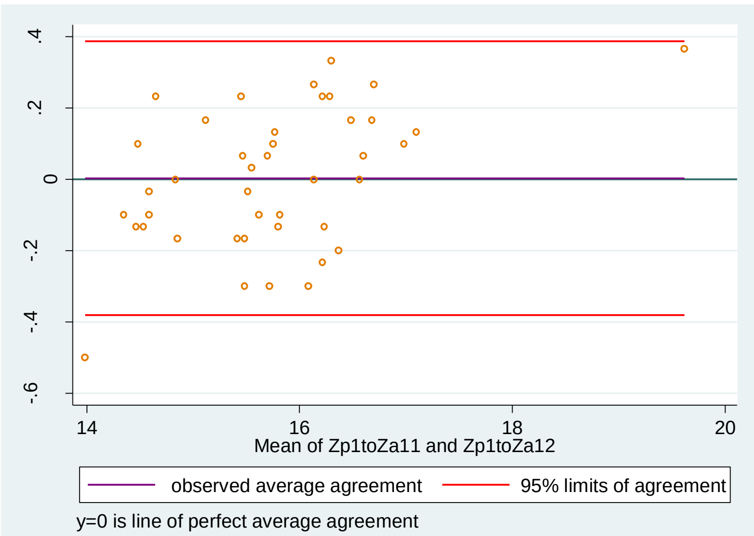
9.3.3 BA Diagrams for Dorsoventral Cephalometric (DVC) Repeatability Study



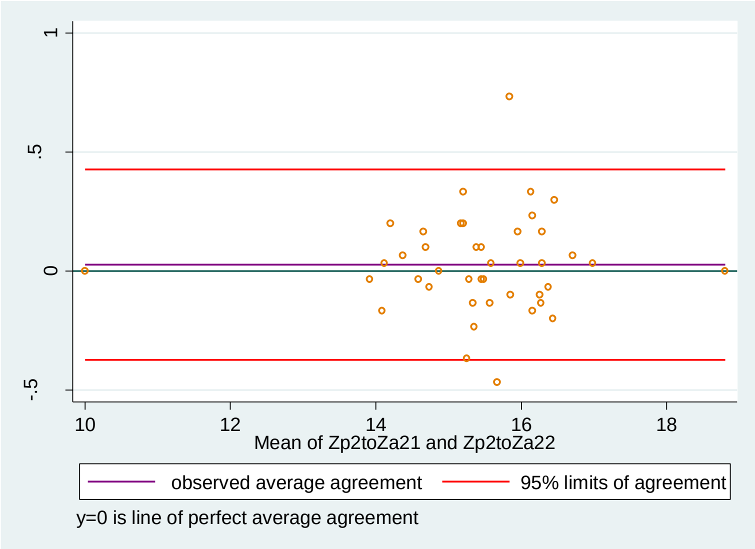
DVC: Occipital to Snout Length (O to N)



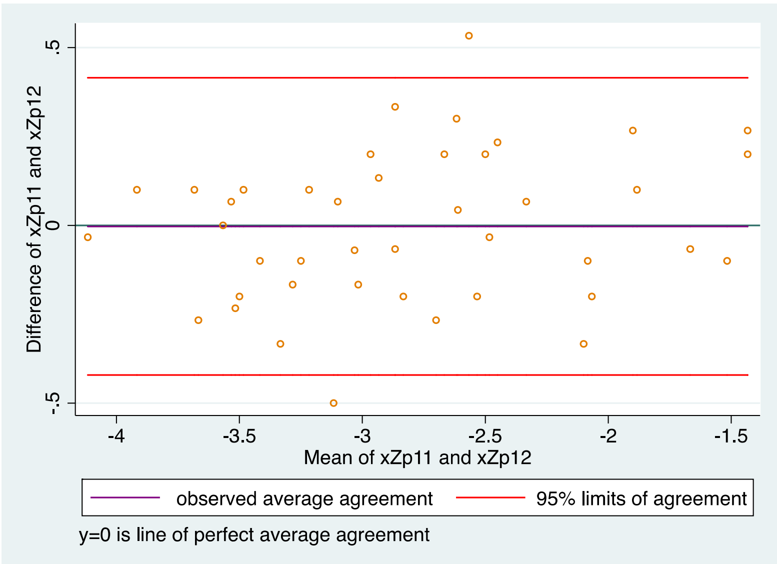
DVC: Cranial Base Length (CBL)



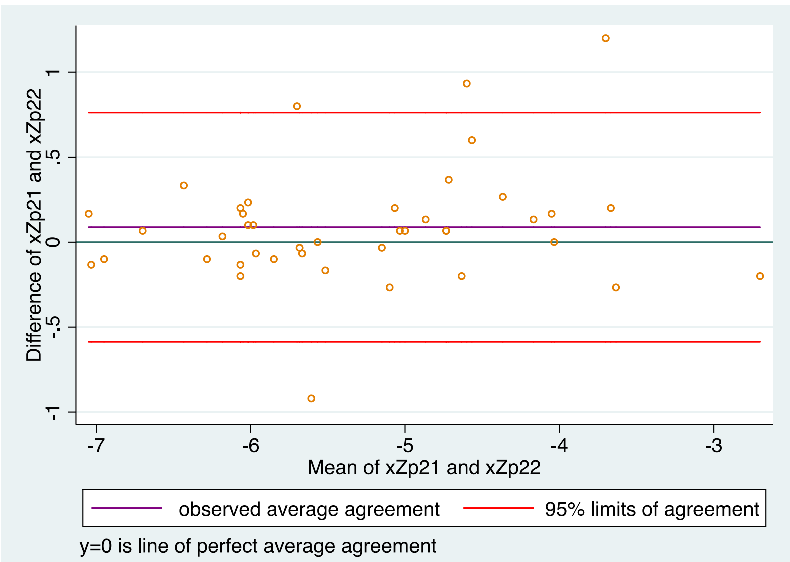
DVC: Left Hand Side Zygomatic Arch Length (Zp1 to Za1)



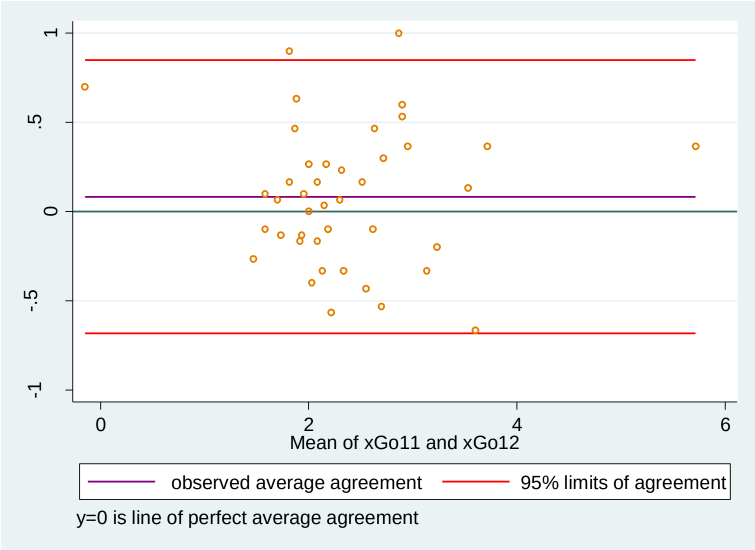
DVC: Right Hand Side Zygomatic Arch Length (Zp2 to Za2)



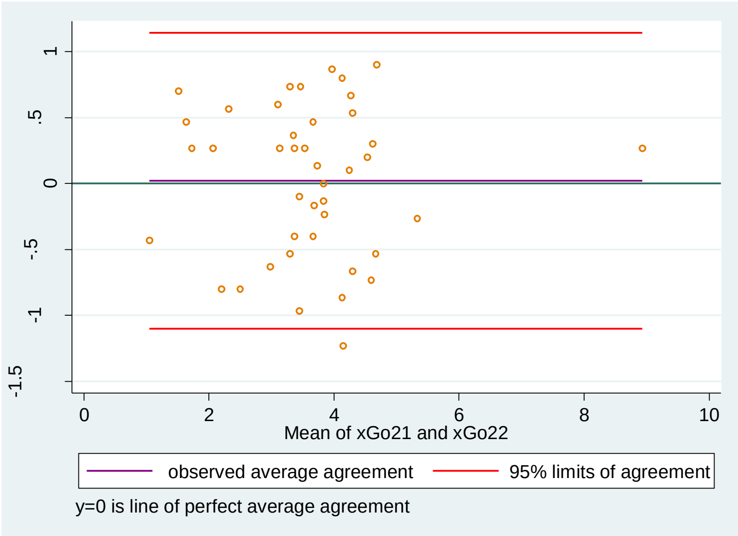
DVC: Sagittal Projection of Left Hand Side Zygomatic Process Posterior (xZp1)



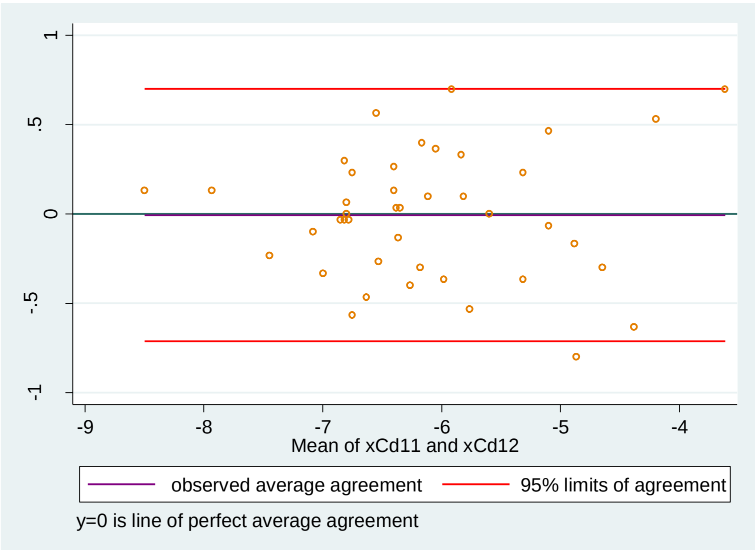
DVC: Sagittal Projection of Right Hand Side Zygomatic Process Posterior (xZp2)



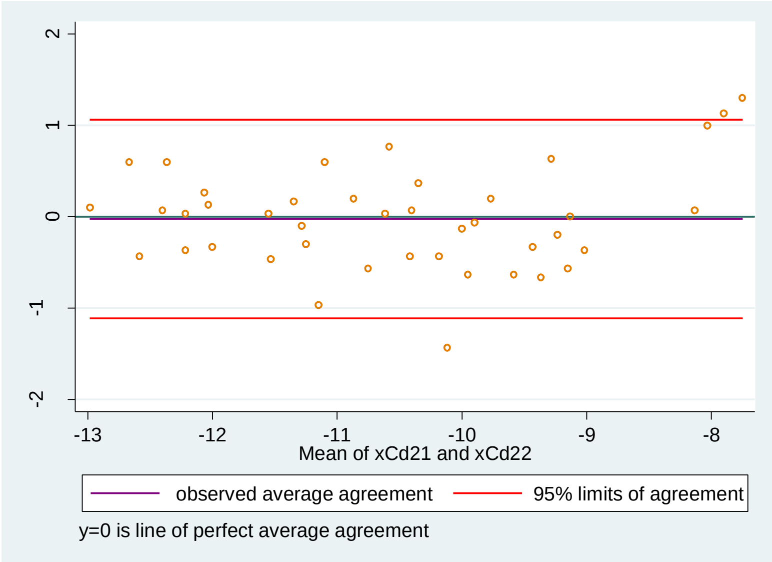
DVC: Sagittal Projection of Left Hand Side Gonion



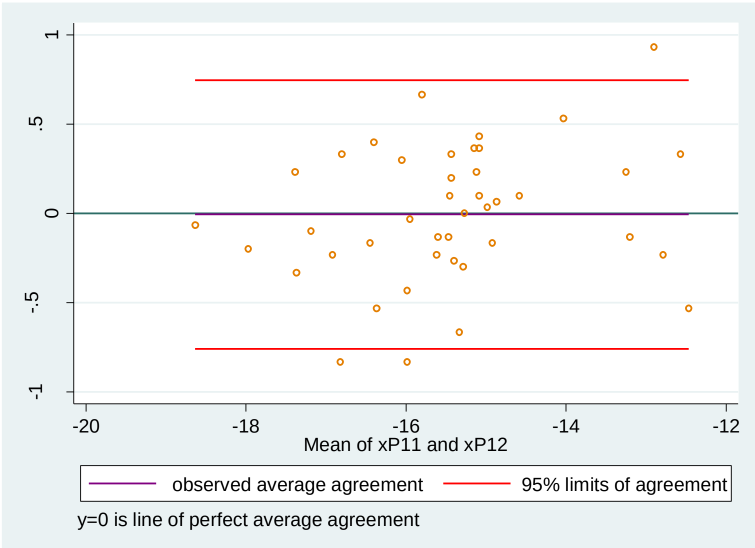
DVC: Sagittal Projection of Right Hand Side Gonion



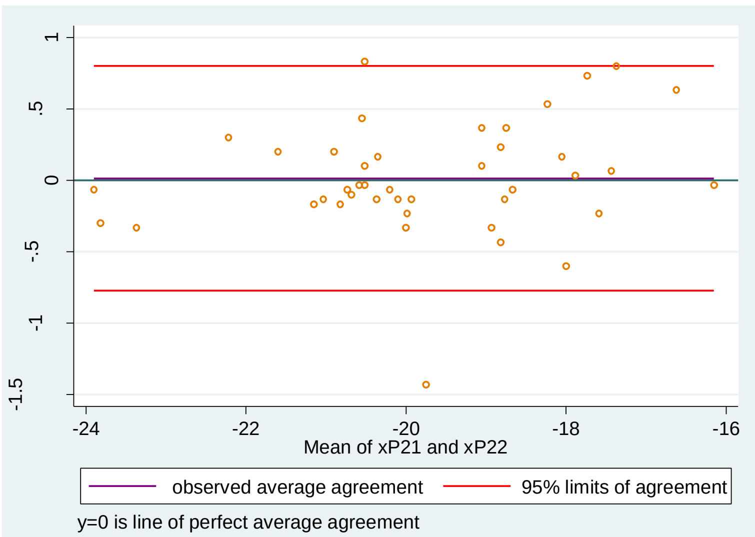
DVC: Sagittal Projection of Left Hand Side Coronoid Process (xCd1)



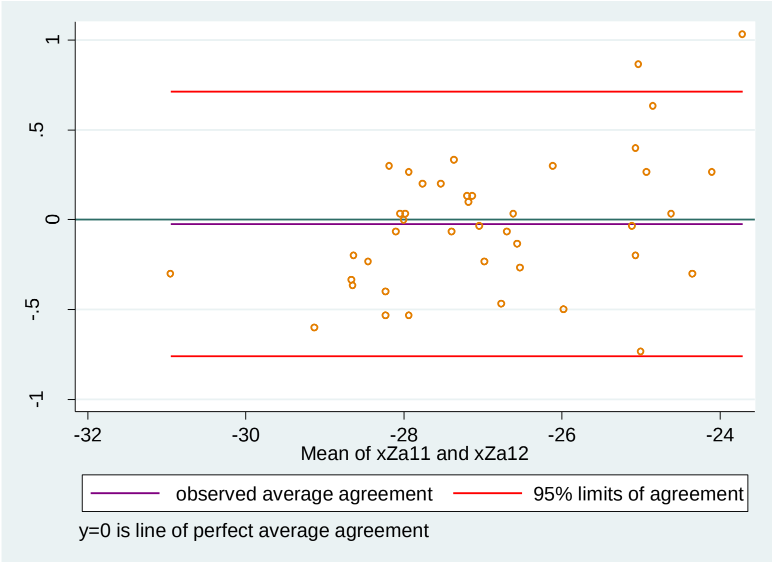
DVC: Sagittal Projection of Right Hand Side Coronoid Process (xCd2)



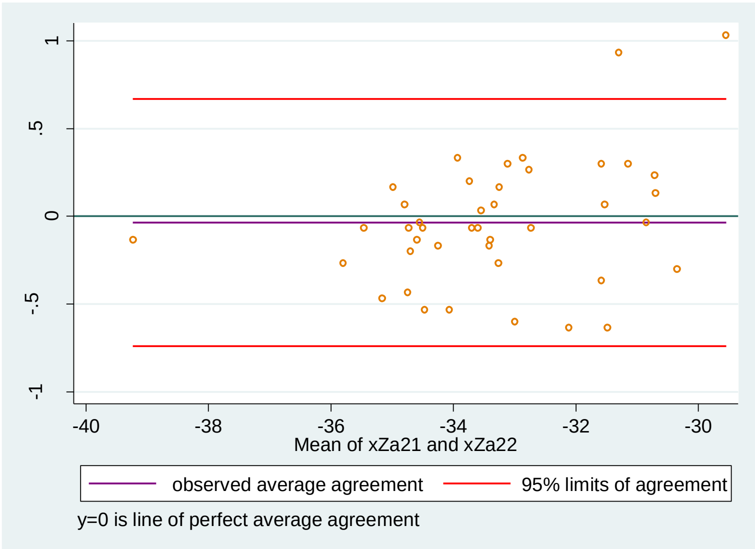
DVC: Sagittal Projection of Left Hand Side Palatal Width (xP1)



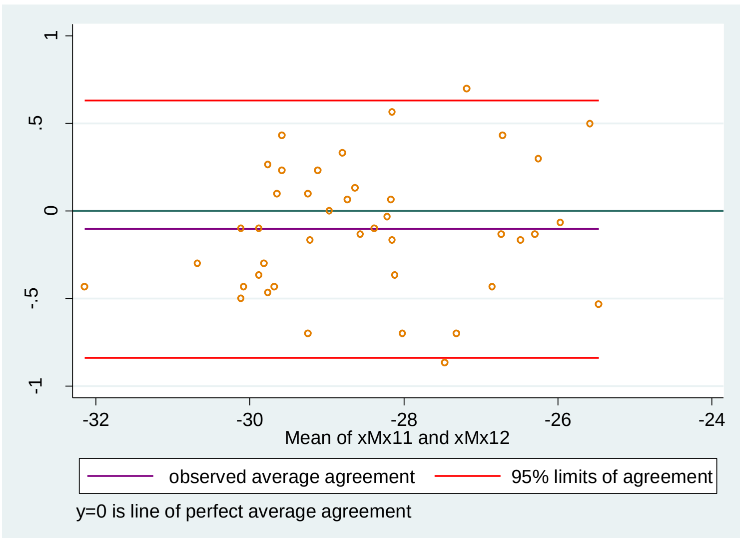
DVC: Sagittal Projection of Right Hand Side Palatal Width (xP2)



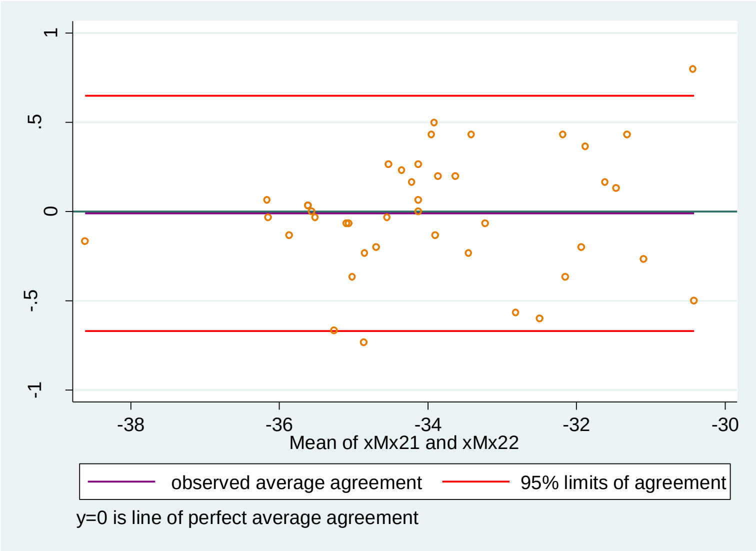
DVC: Sagittal Projection of Left Hand Side Anterior Point on the Zygomatic Arch (xZa1)



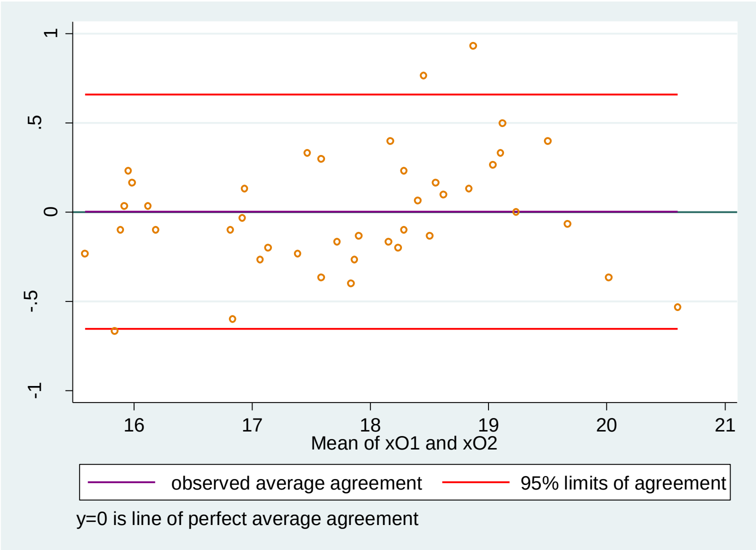
DVC: Sagittal Projection of Right Hand Side Anterior Point on the Zygomatic Arch (xZa2)



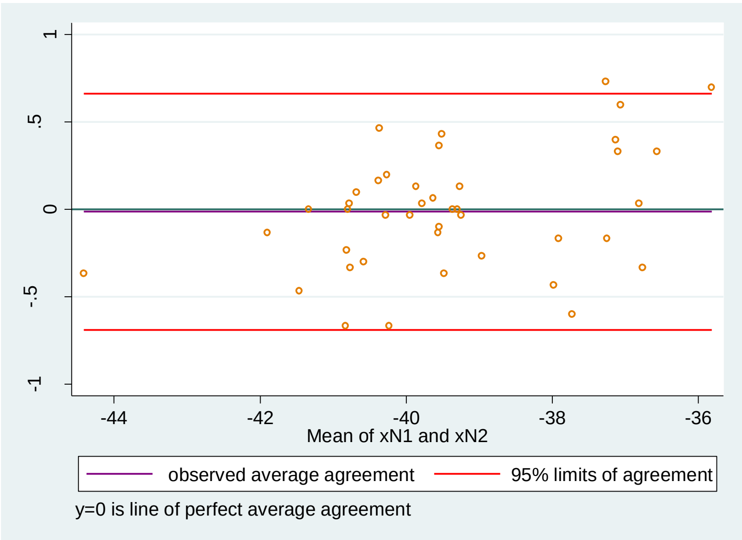
DVC: Sagittal Projection of Left Hand Side Maxillary Process (xMx1)



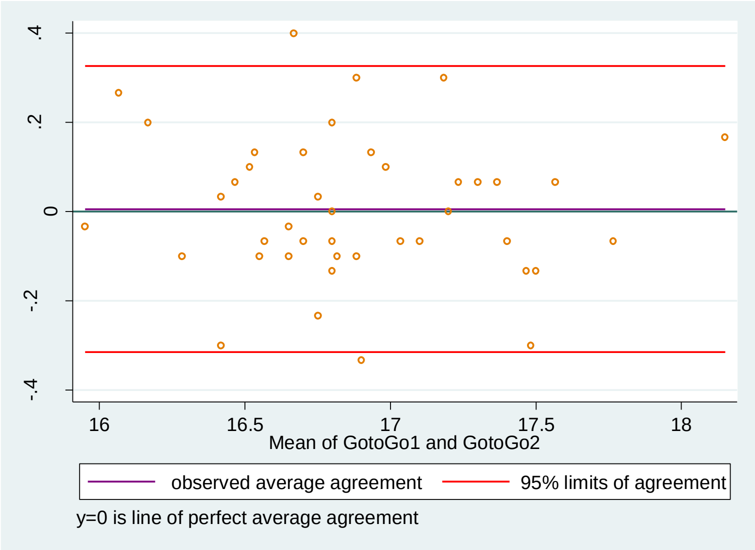
DVC: Sagittal Projection of Right Hand Side Maxillary Process (xMx2)



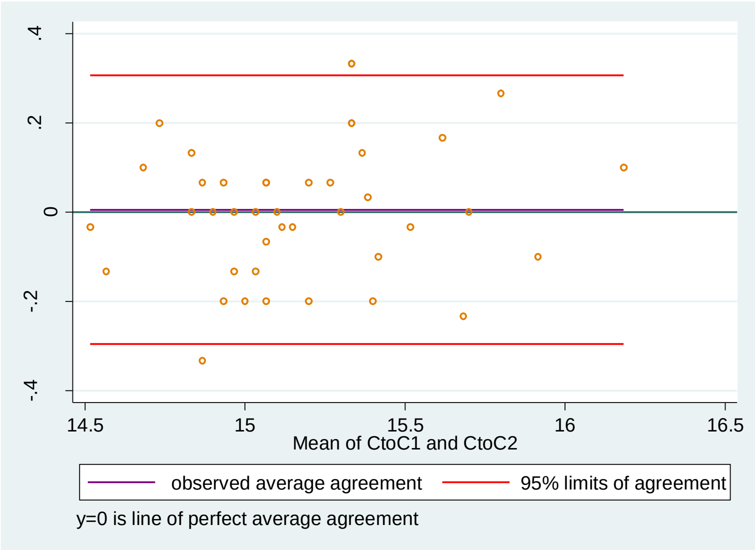
DVC: Sagittal Projection of O



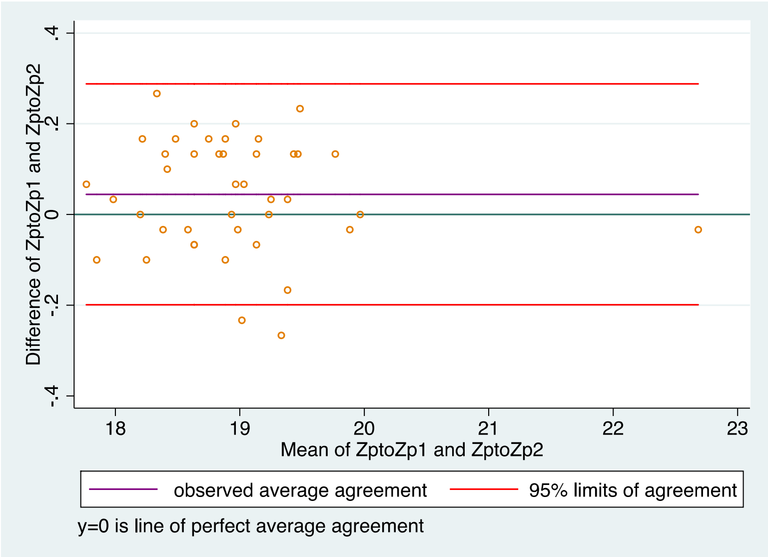
DVC: Sagittal Projection of N



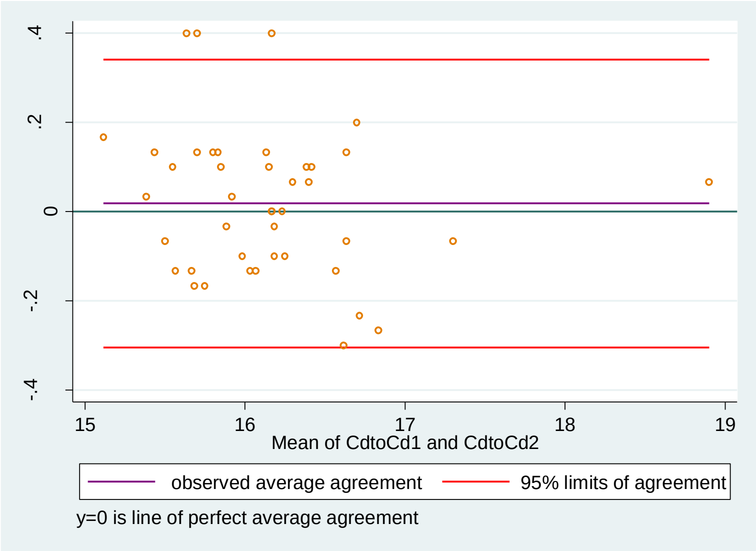
DVC: Intergonial Width (Go1 to Go2)



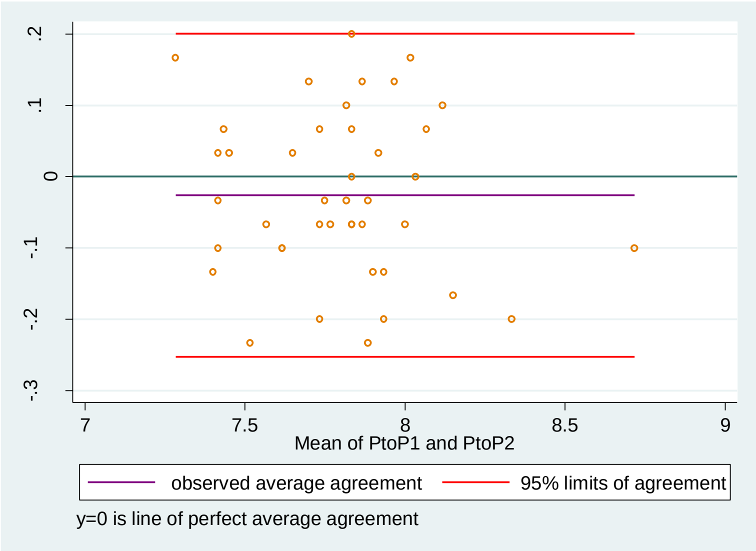
DVC: Intercranial width (C1↔C2)



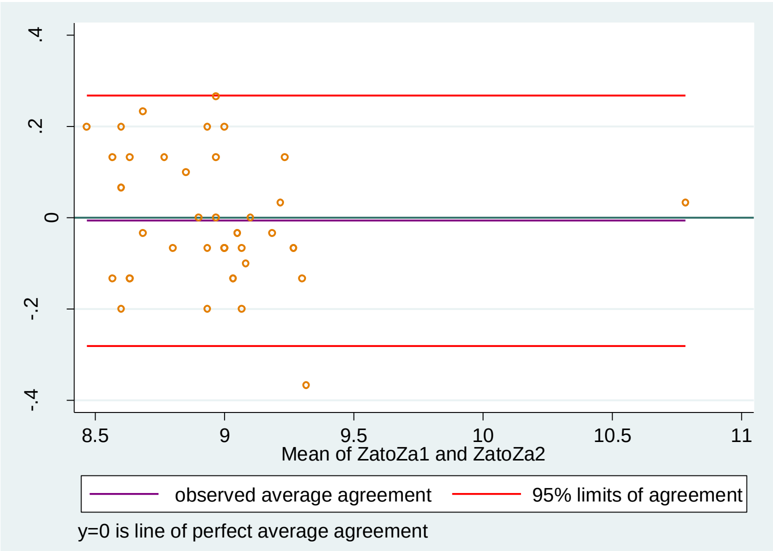
DVC: Interzygomatic Width Posterior (Zp1 to Zp2)



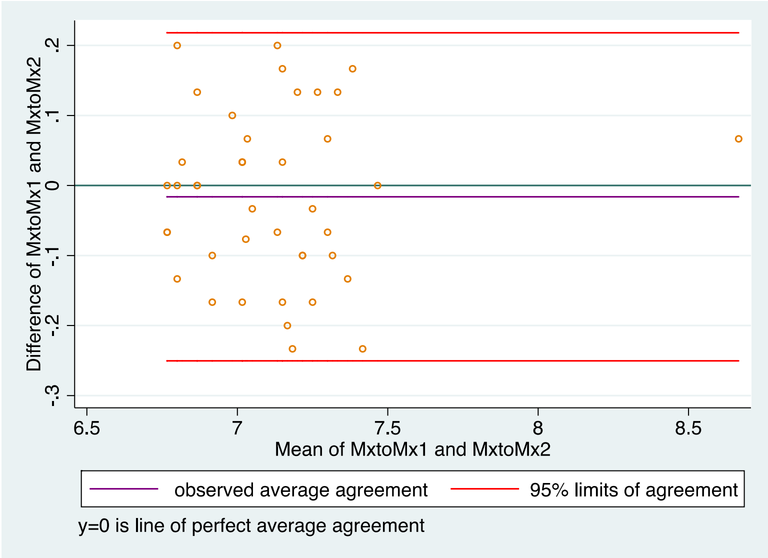
DVC: Intercoronoid Process Width (Cd1 to Cd2)



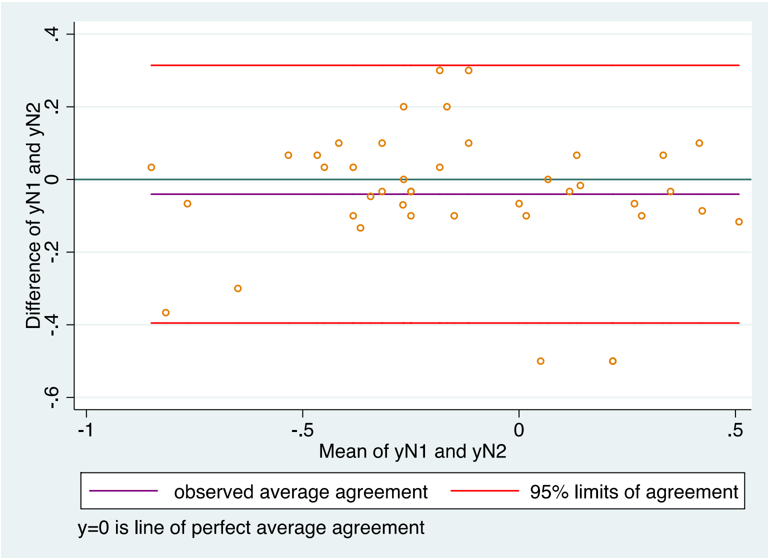
DVC: Palatal Width Difference



DVC: Interzygomatic Arch Width Anterior (Za1 to Za2)



DVC: Intermaxillary Arch Width (Mx1 to Mx2)



DVC: Vertical projection of snout (yN)

9.4 Appendix 4: Lateral Cephalometric (LC) Boxplots

9.4.1 LC-Short Term (ST) Boxplots

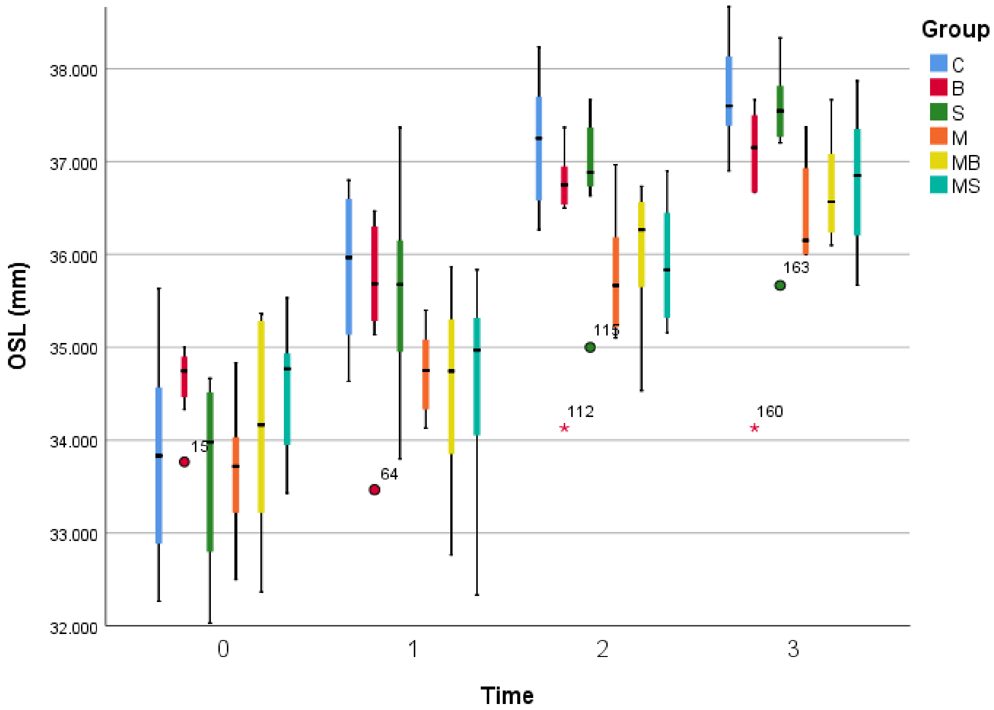


Figure 84: Boxplot of OSL (mm) LC-ST groups at timepoints T0 to T3

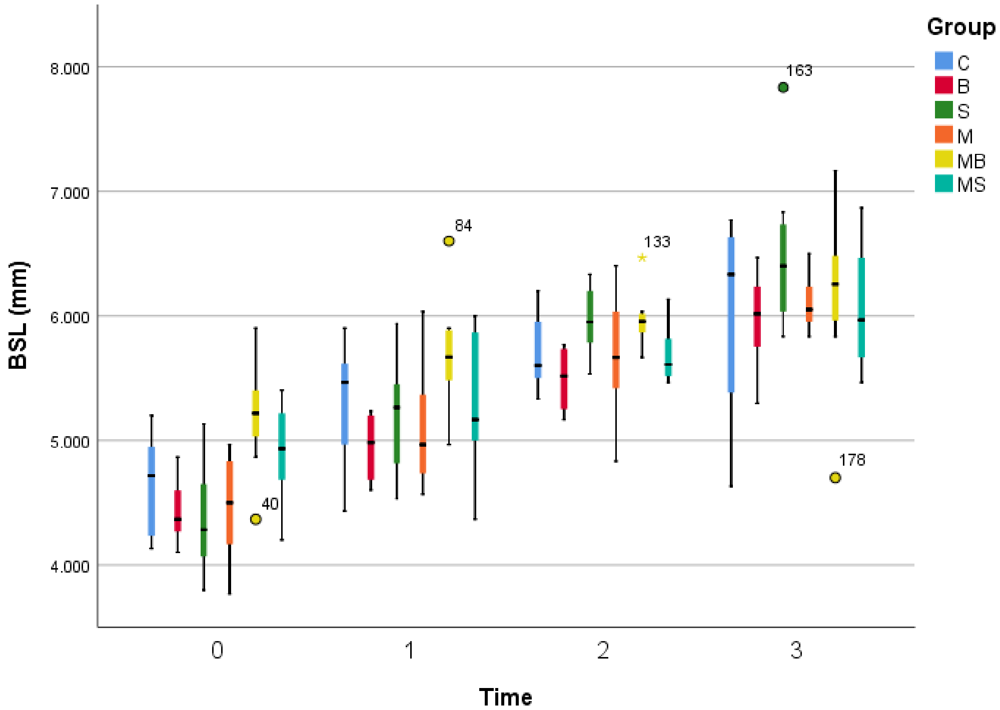


Figure 85: Boxplot of BSL (mm) LC-ST groups at timepoints T0 to T3

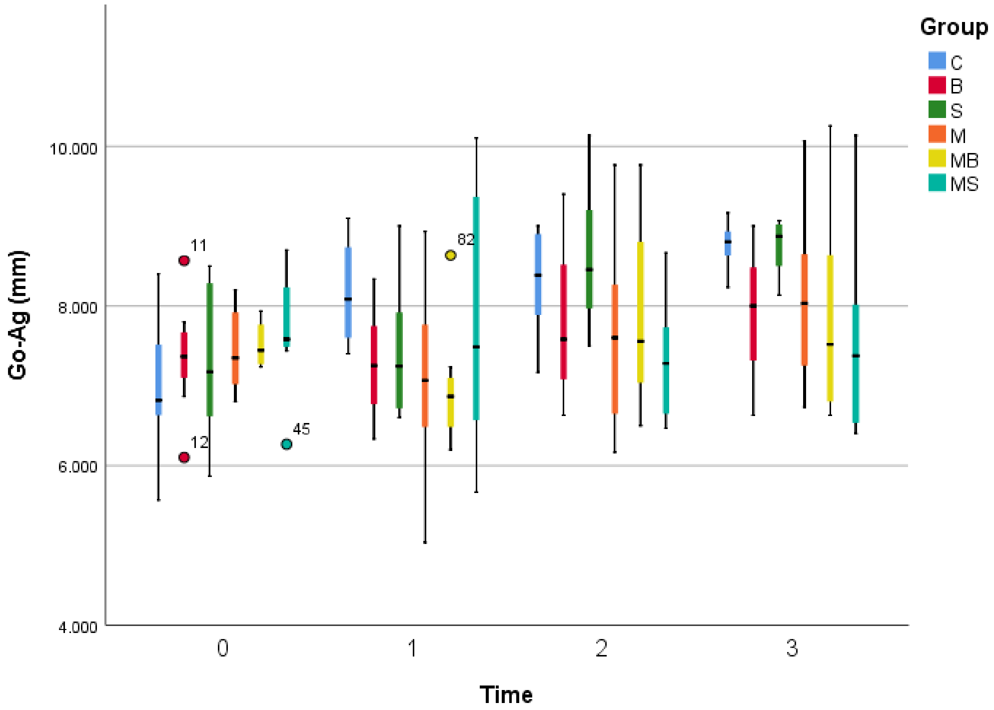


Figure 86: Boxplot of Go to Ag (mm) for the LC-ST Group at T0 to T3

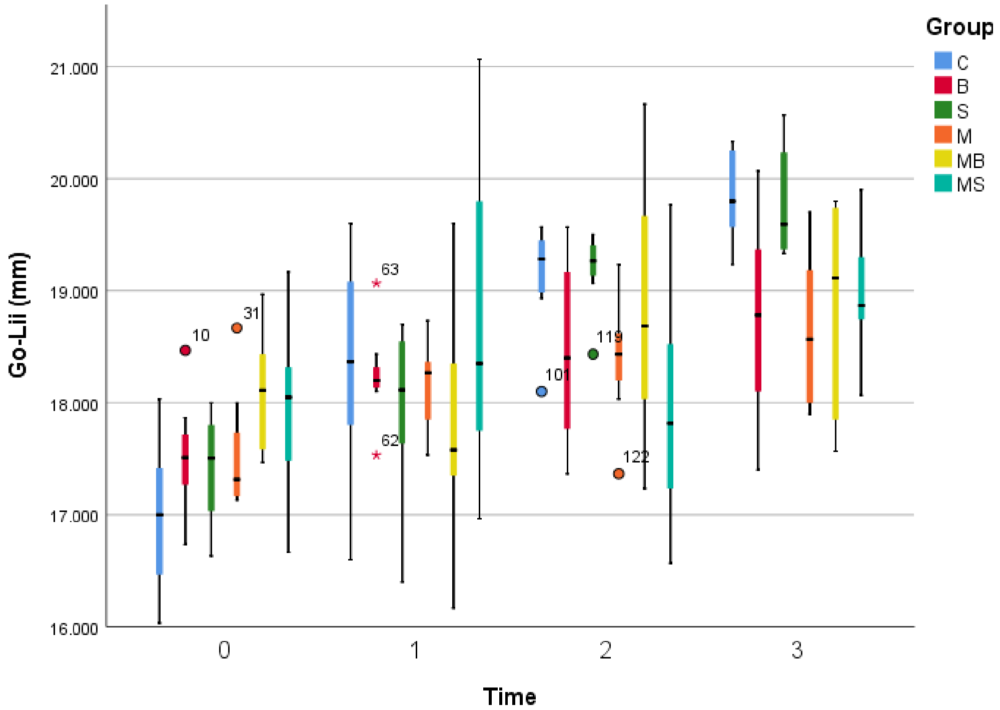


Figure 87: Boxplot of Go to Lii (mm) for the LC-ST Group at T0 to T3

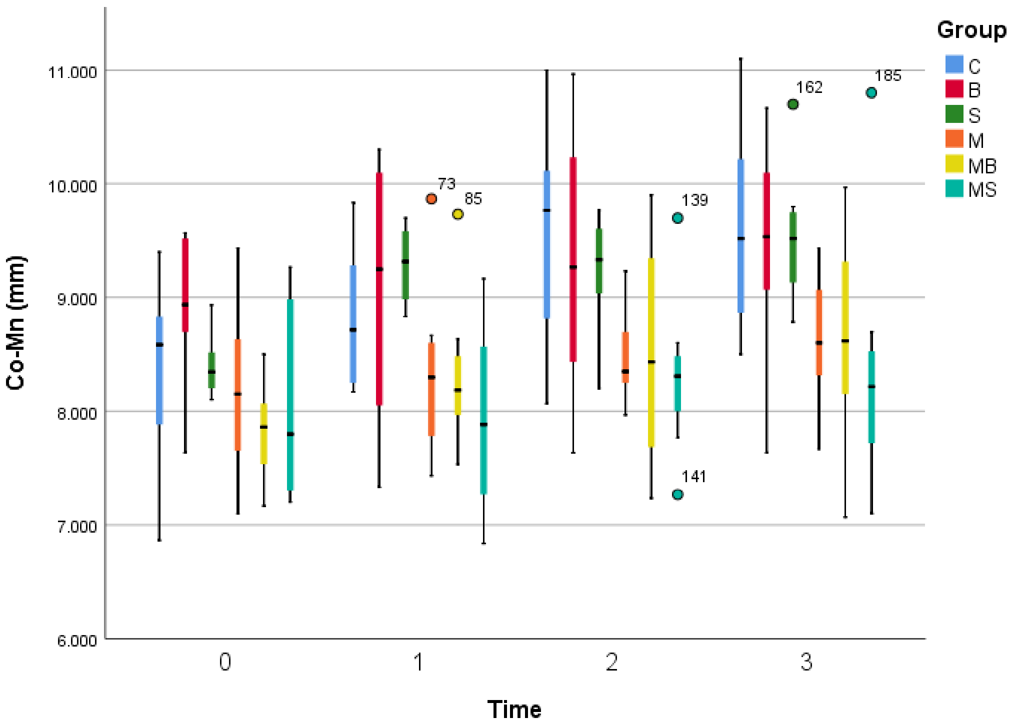


Figure 88: Boxplot of Co to Mn (mm) LC-ST groups at timepoints T0 to T3

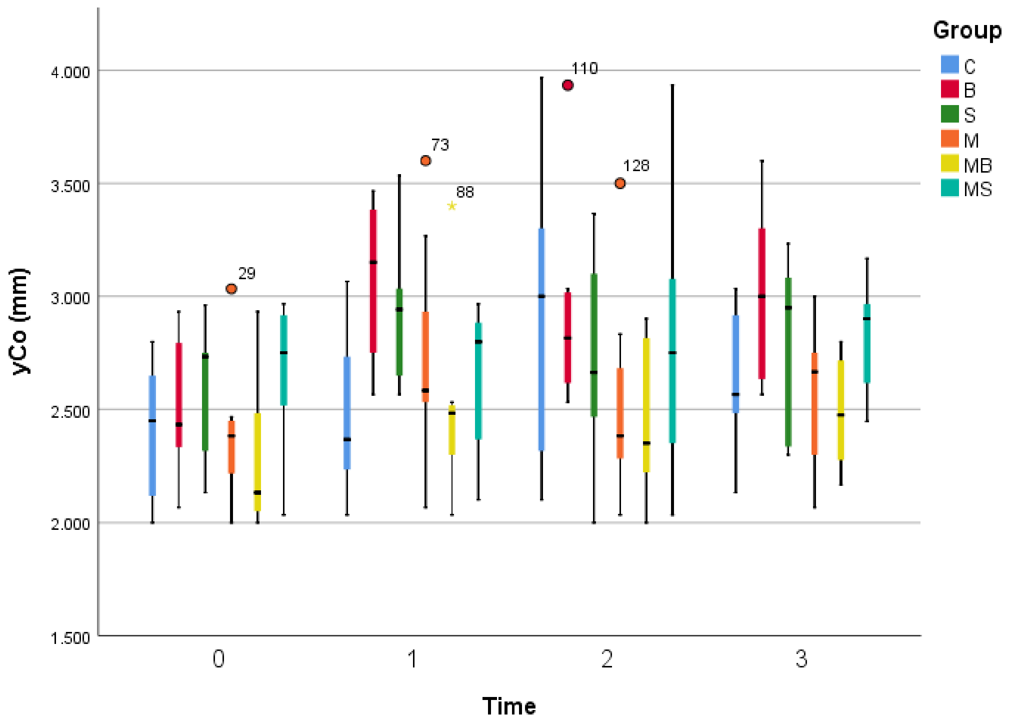


Figure 89: Boxplot of yCo (mm) LC-ST groups at timepoints T0 to T3

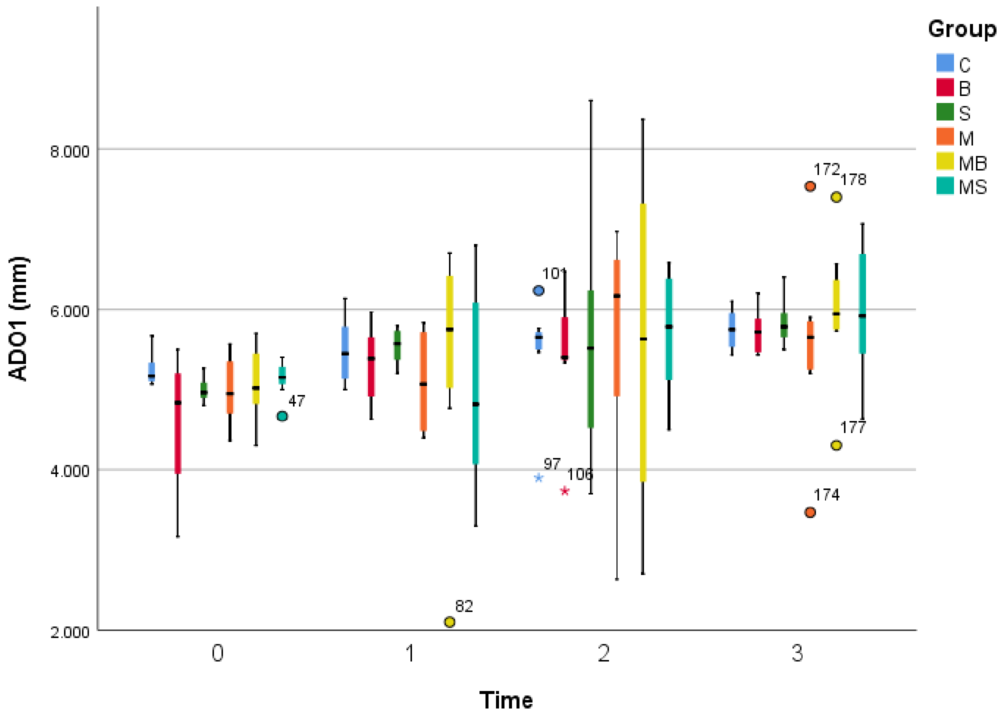


Figure 90: Boxplot of ADO1 (mm) LC-ST groups at timepoints T0 to T3

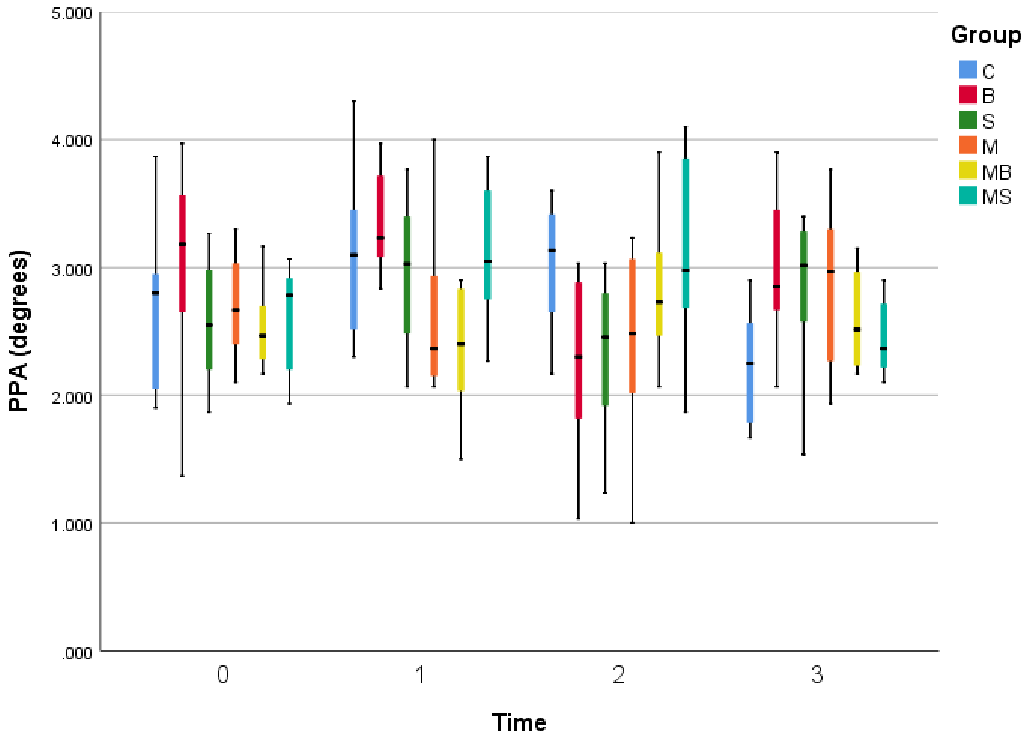


Figure 91: Boxplot of PPA (°) LC-ST groups at timepoints T0 to T3

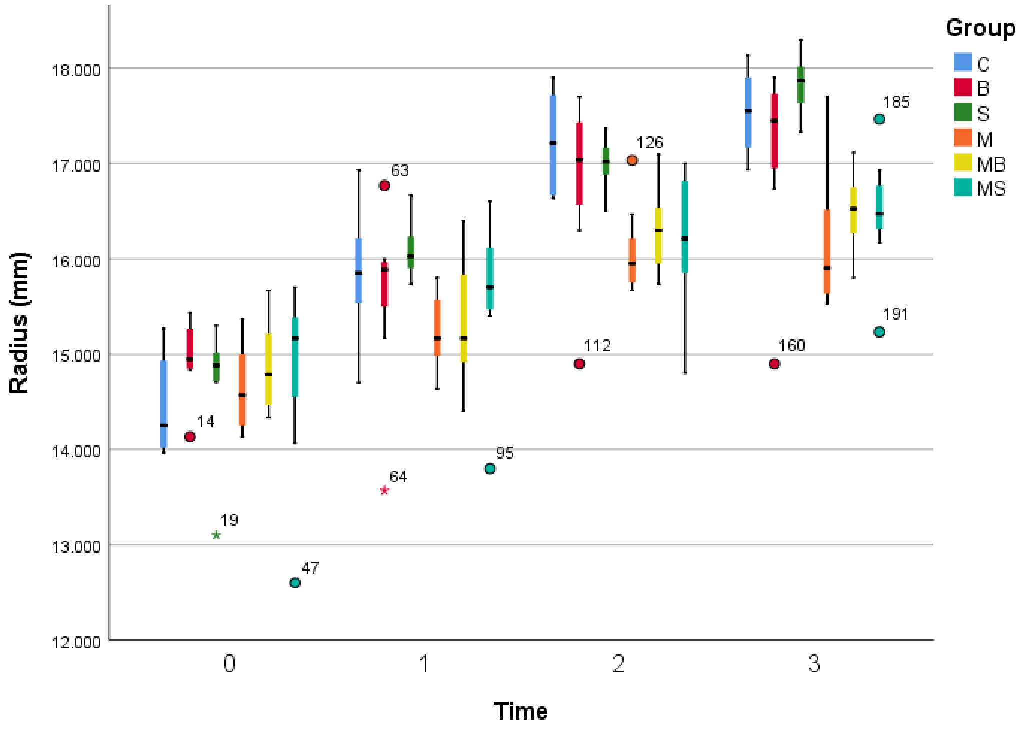


Figure 92: Boxplot of Radius f(mm) LC-ST groups at timepoints T0 to T

9.4.2 LC-Long-term (LT) Boxplots

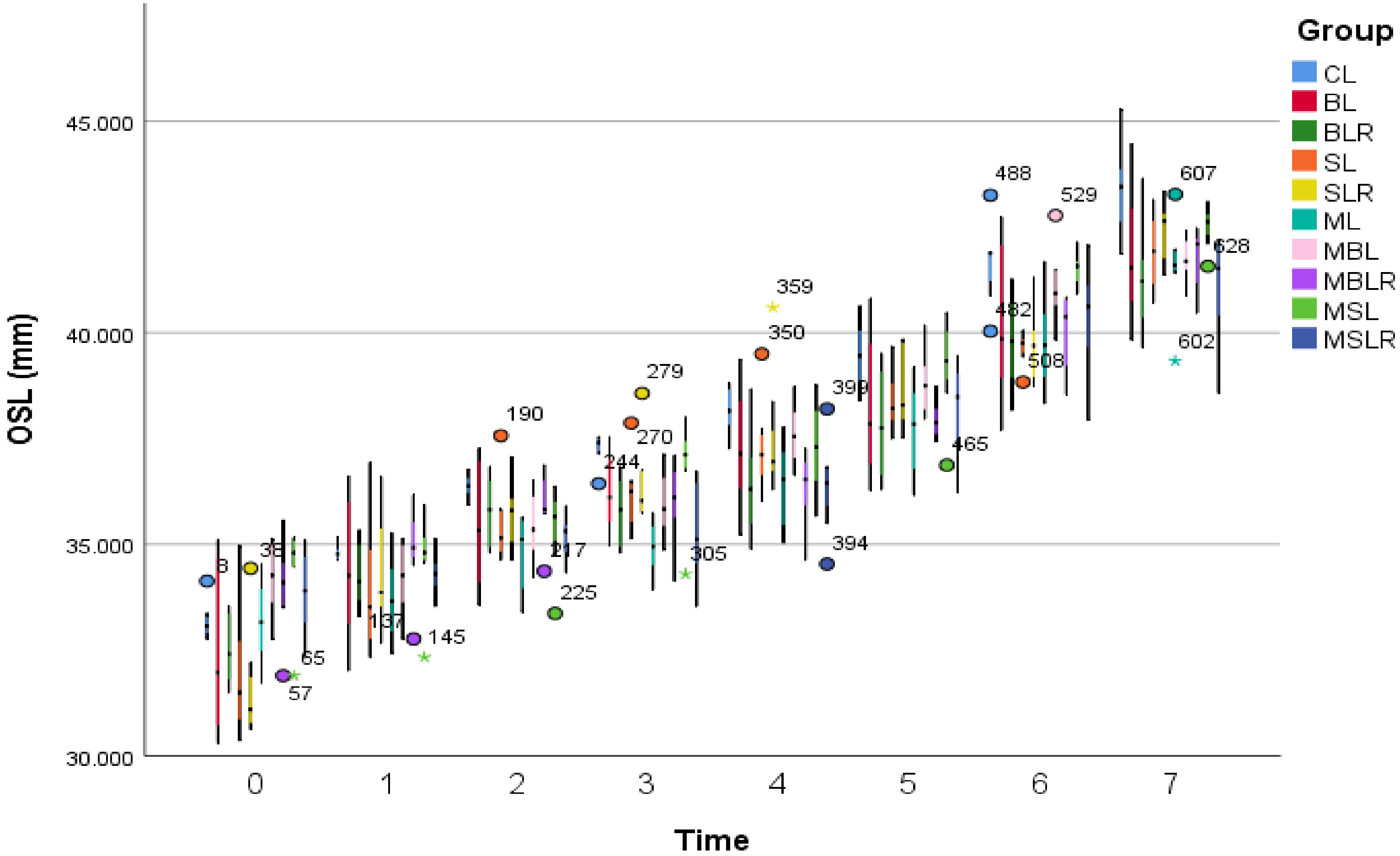


Figure 93: Boxplot of OSL (mm) LC-LT groups at timepoints T0 to T7

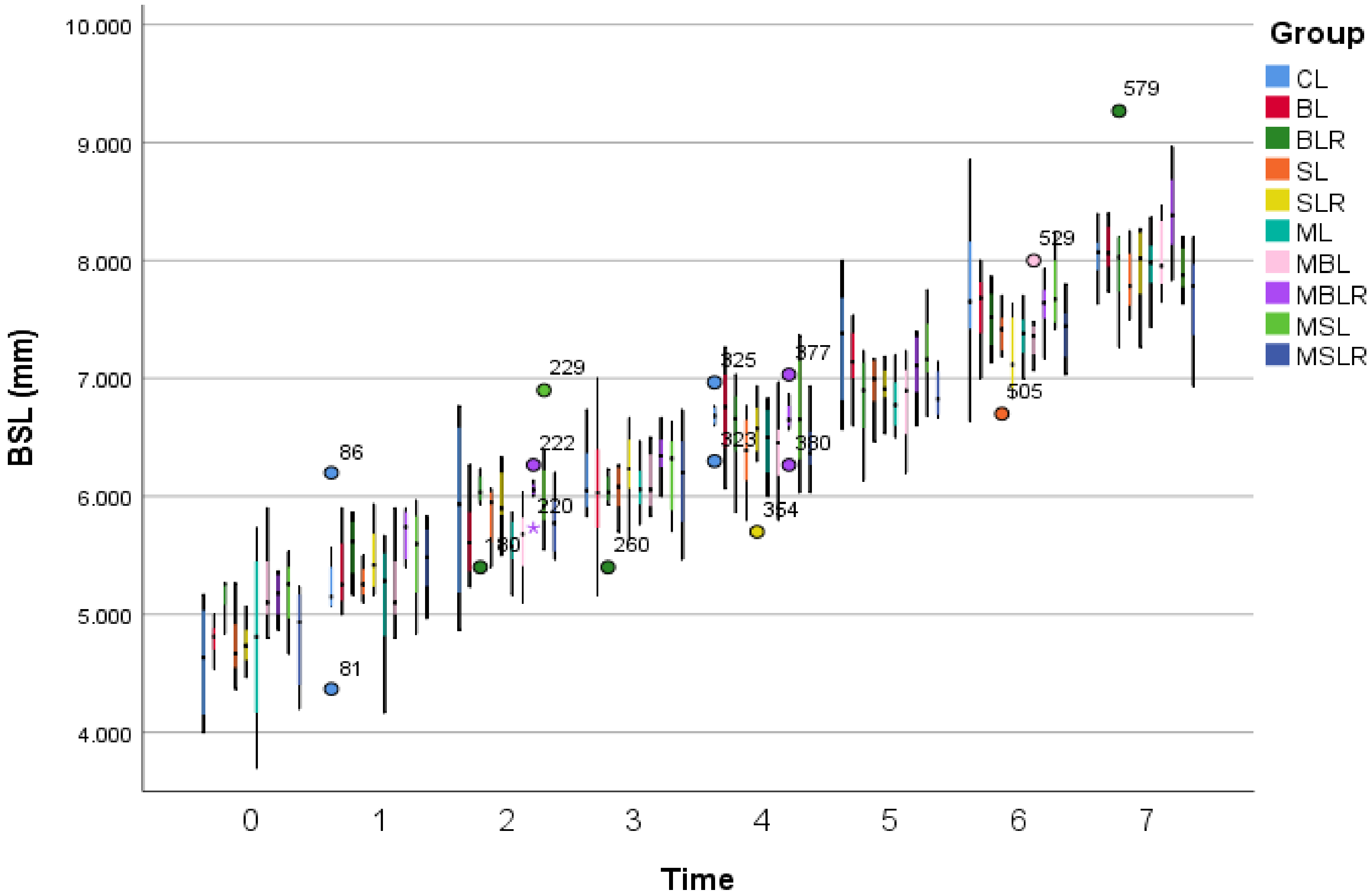


Figure 94: Boxplot of BSL (mm) LC-LT groups at timepoints T0 to T7

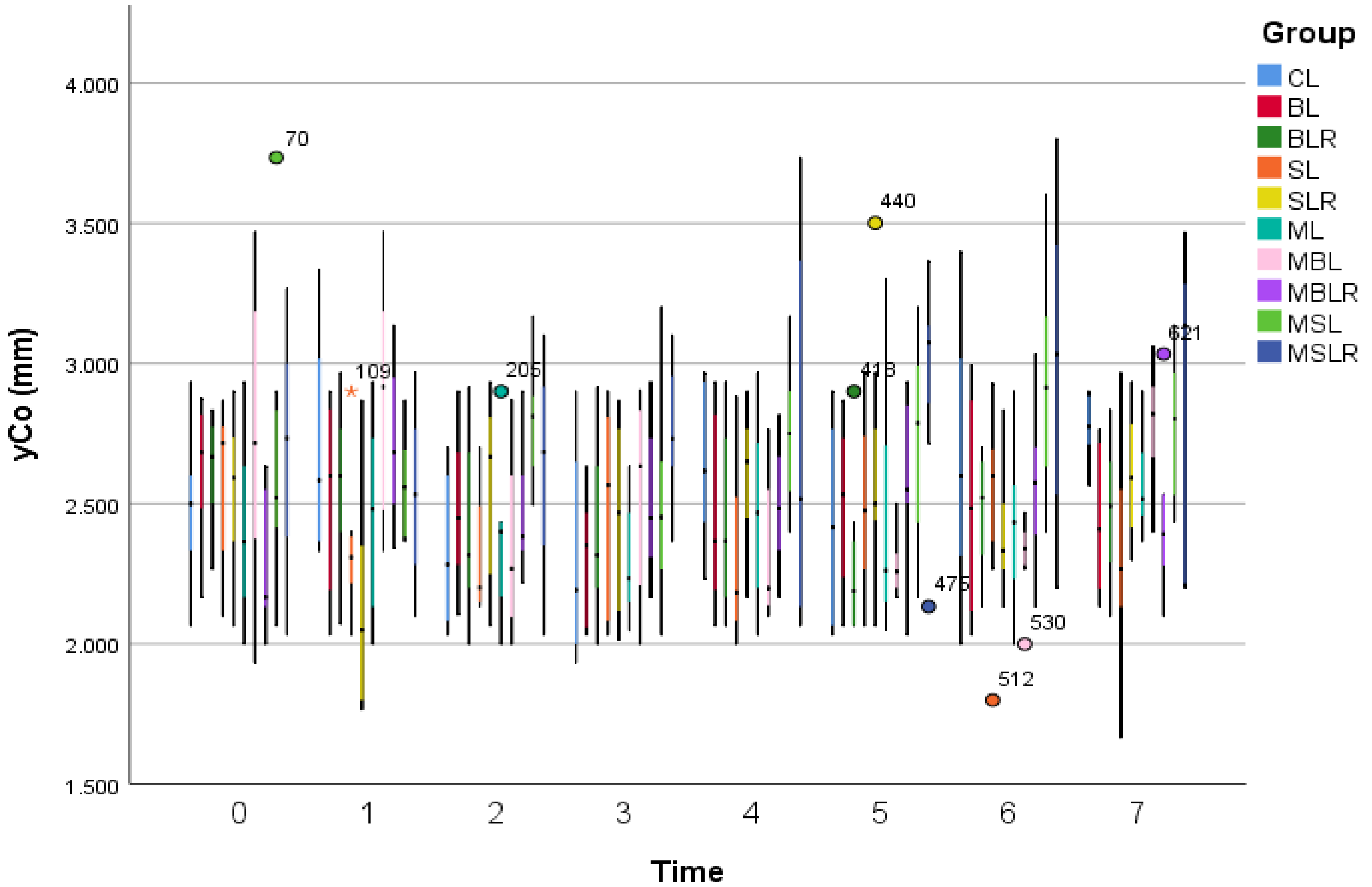


Figure 95: Boxplot of yCo (mm) LC-LT groups at timepoints T0 to T7

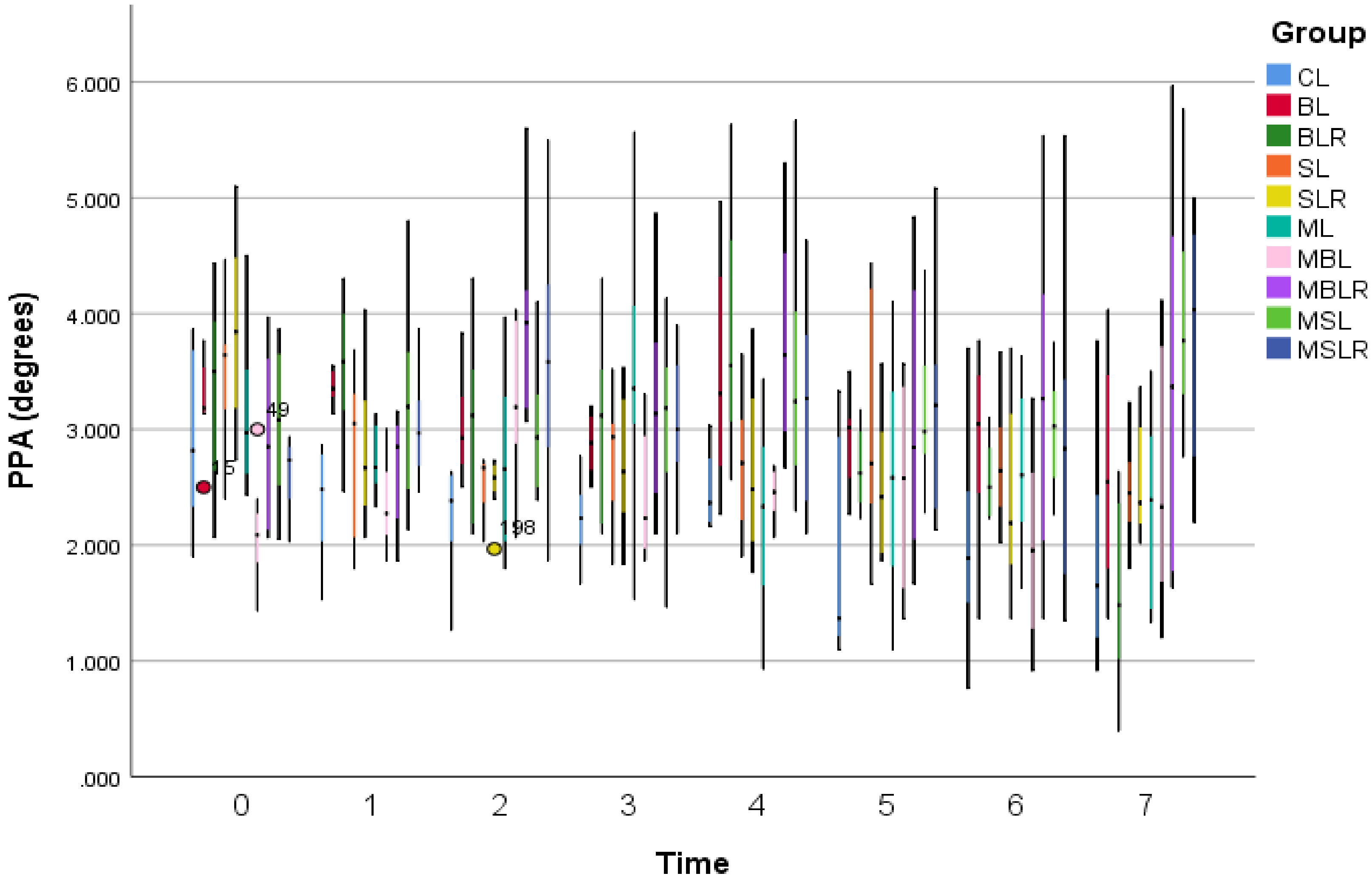


Figure 96: Boxplot of PPA (º) for DVC-LT Group from T0 to T7

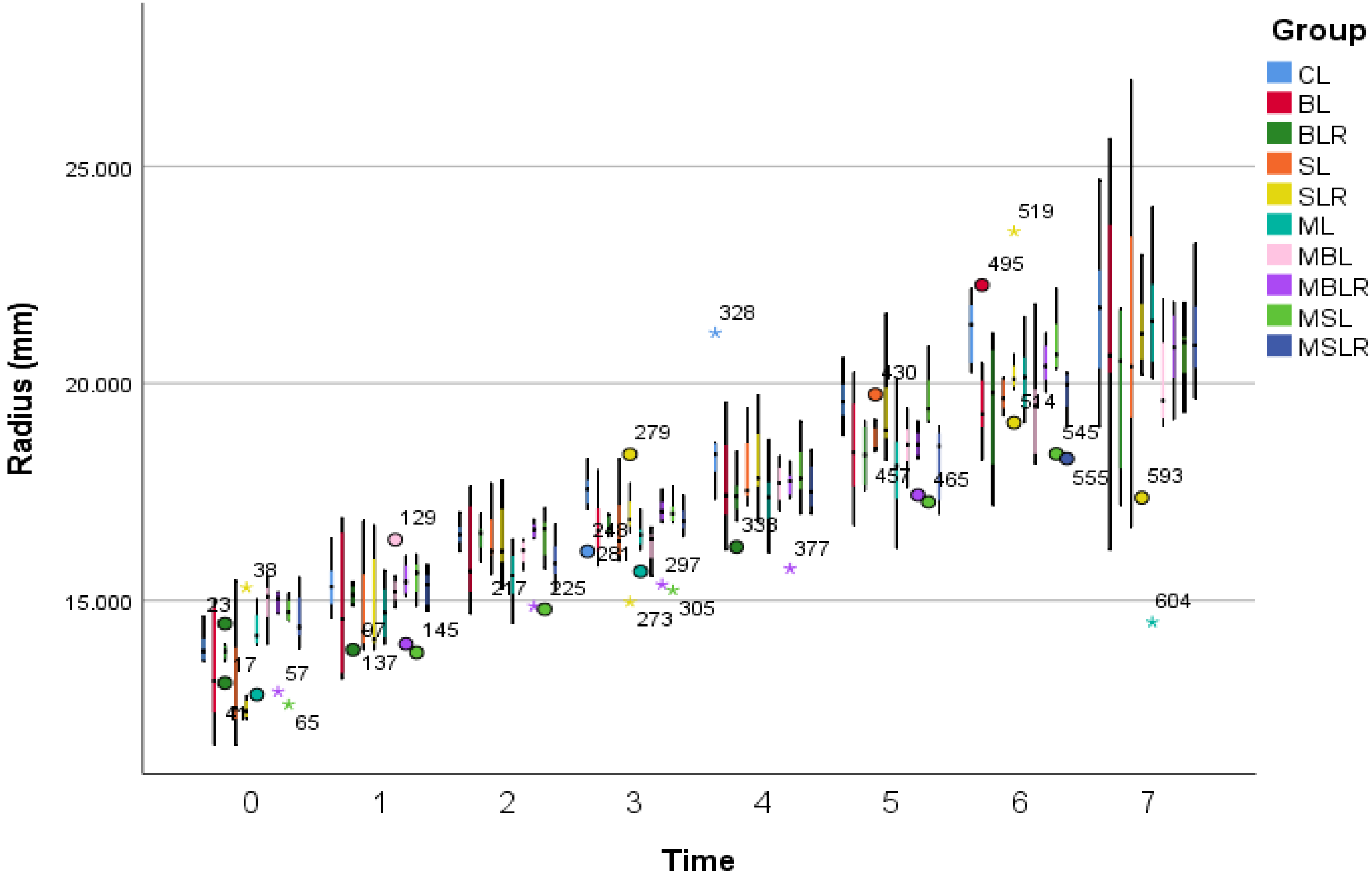


Figure 97: Boxplot of Radius (mm) for DVC-LT Group from T0 to T7

9.5 Appendix 5: Dorsoventral Cephalometric (DVC) Boxplots

9.5.1 DVC-Short-term (ST) Boxplots

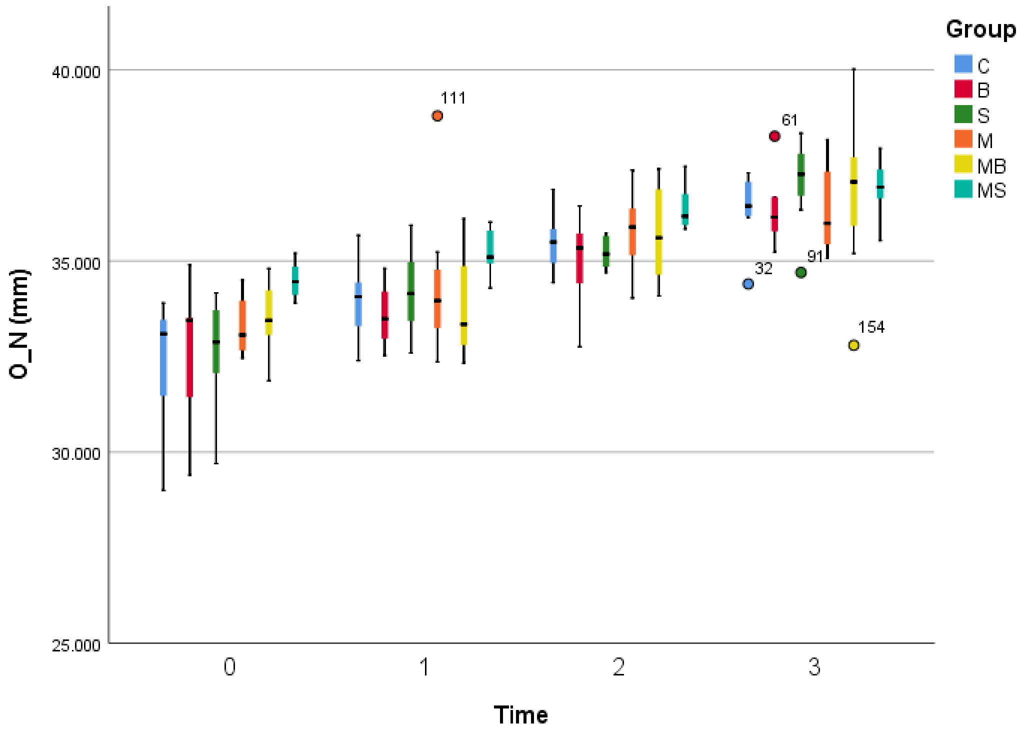


Figure 98: Boxplot of O↔N (mm) for DVC-ST groups at timepoints T0 to T3

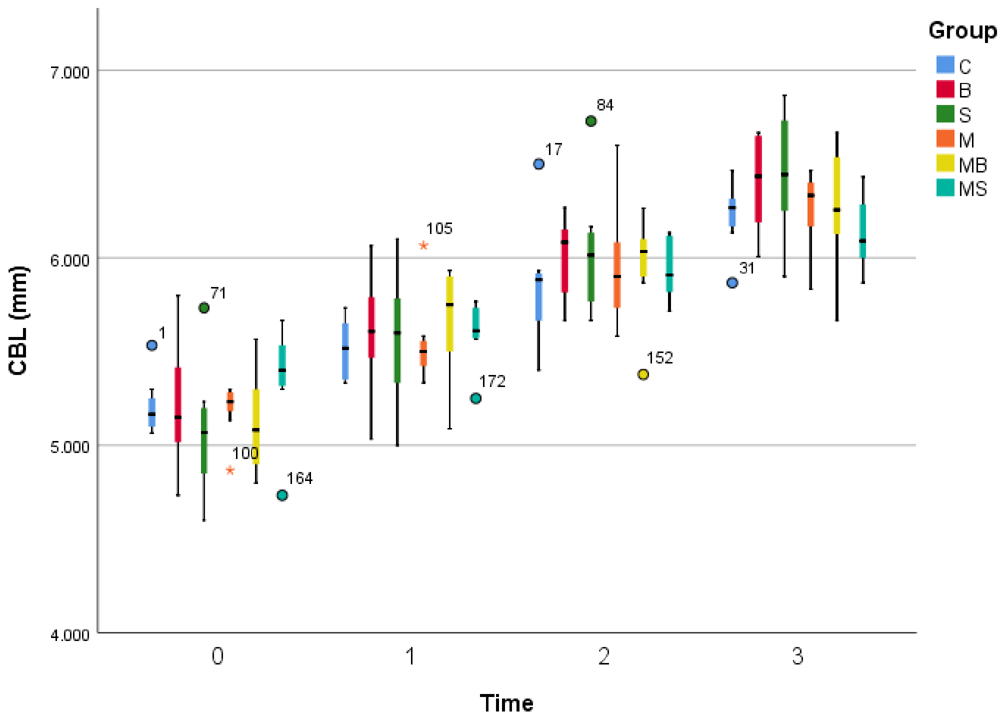


Figure 99: Boxplots of CBL (mm) for DVC-ST groups at timepoints T0 to T3

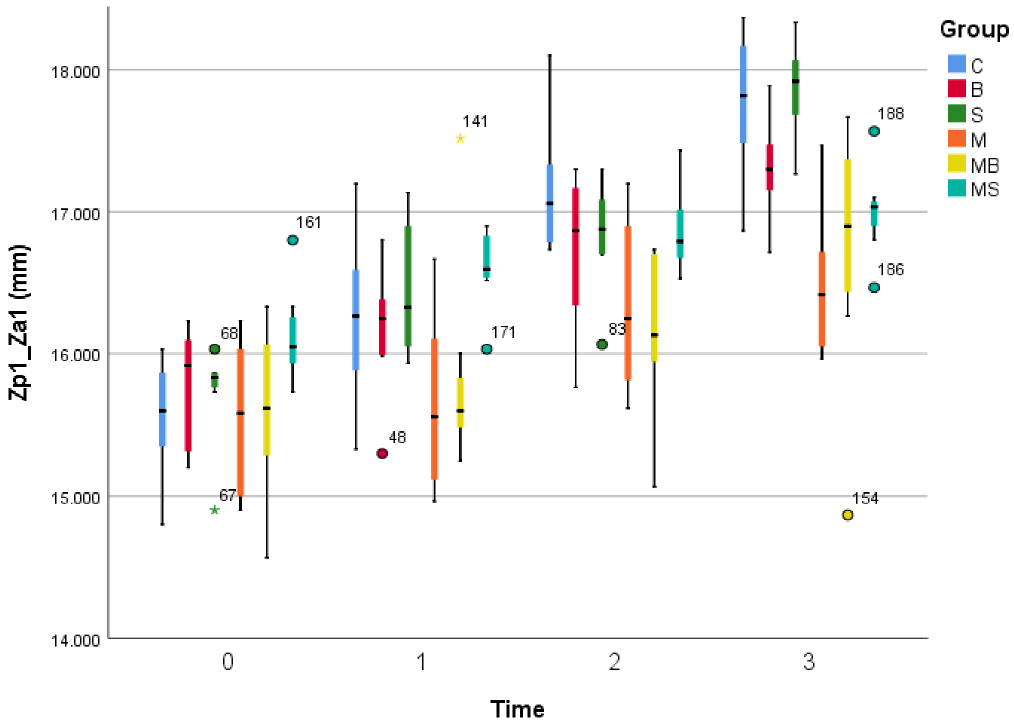


Figure 100: Boxplot of Zp1↔Za1 (mm) for DVC-ST groups at timepoints T0 to T3

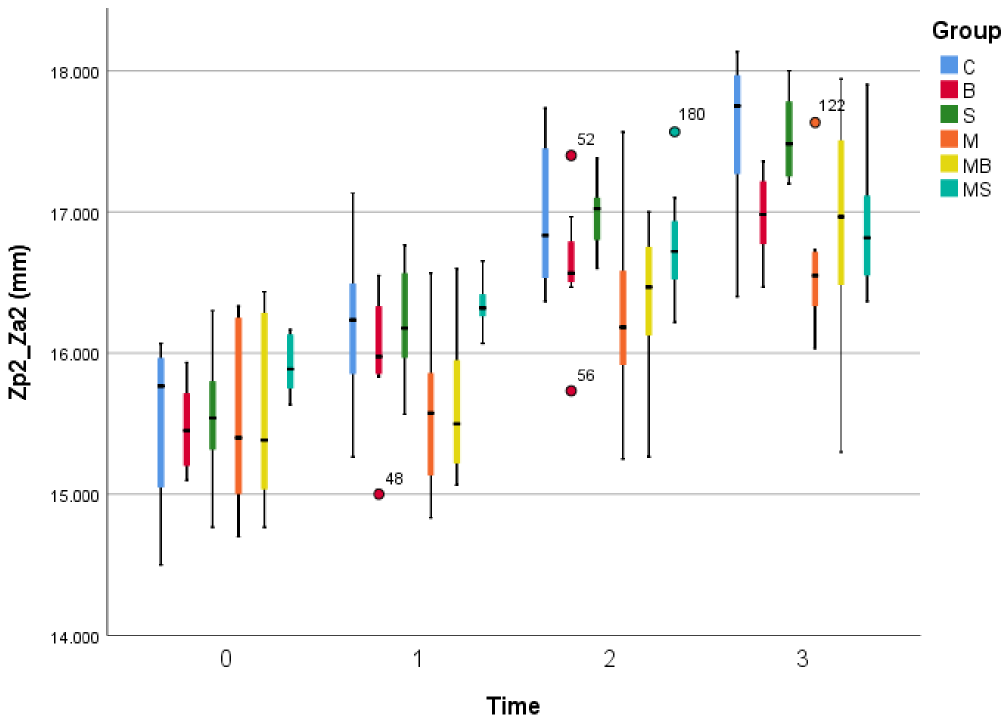


Figure 101: Boxplot of Zp2↔Za2 (mm) for DVC-ST groups at timepoints T0 to T3

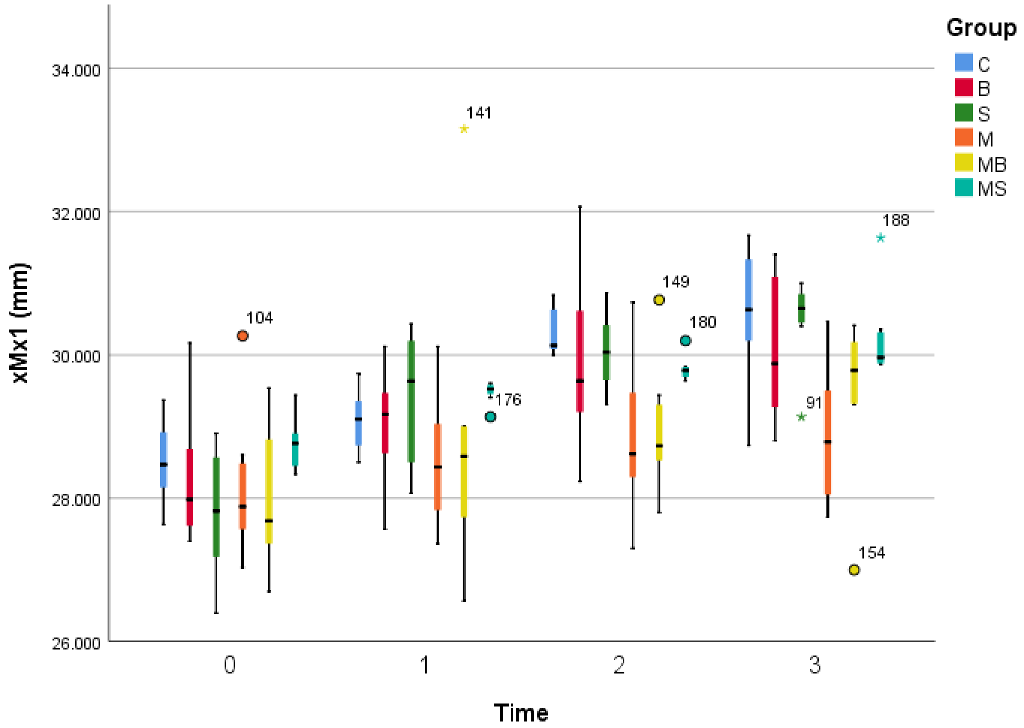


Figure 102: Boxplot of xMx1 (mm) for DVC-ST groups at timepoints T0 to T3

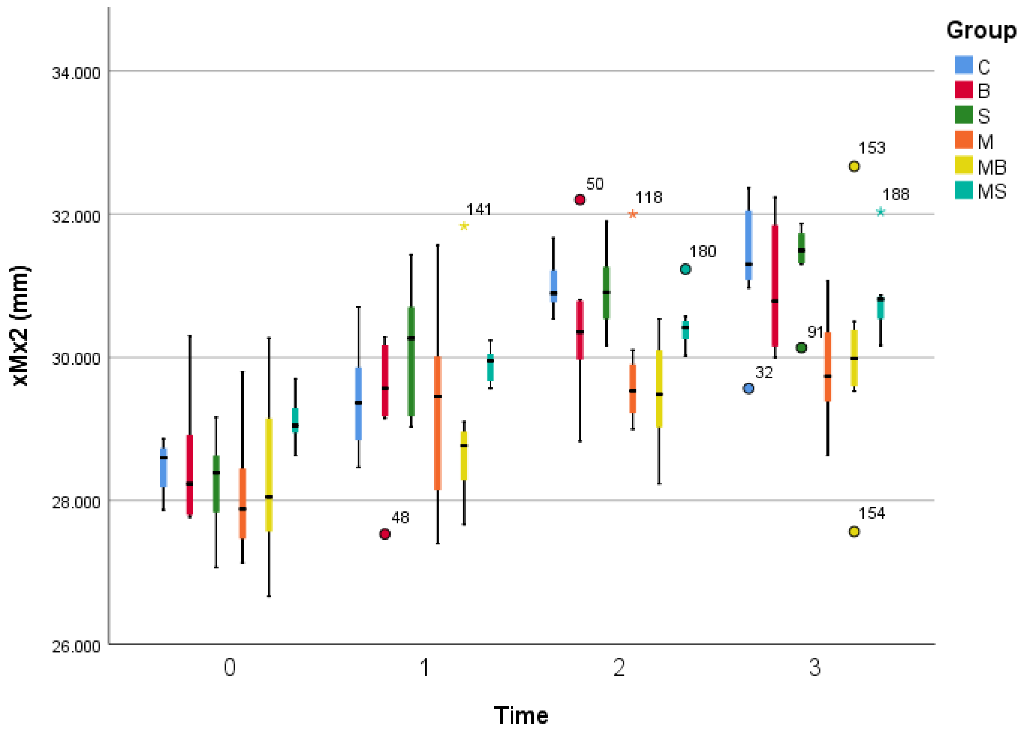


Figure 103: Boxplot of xMx2 (mm) for DVC-ST groups at timepoints T0 to T7

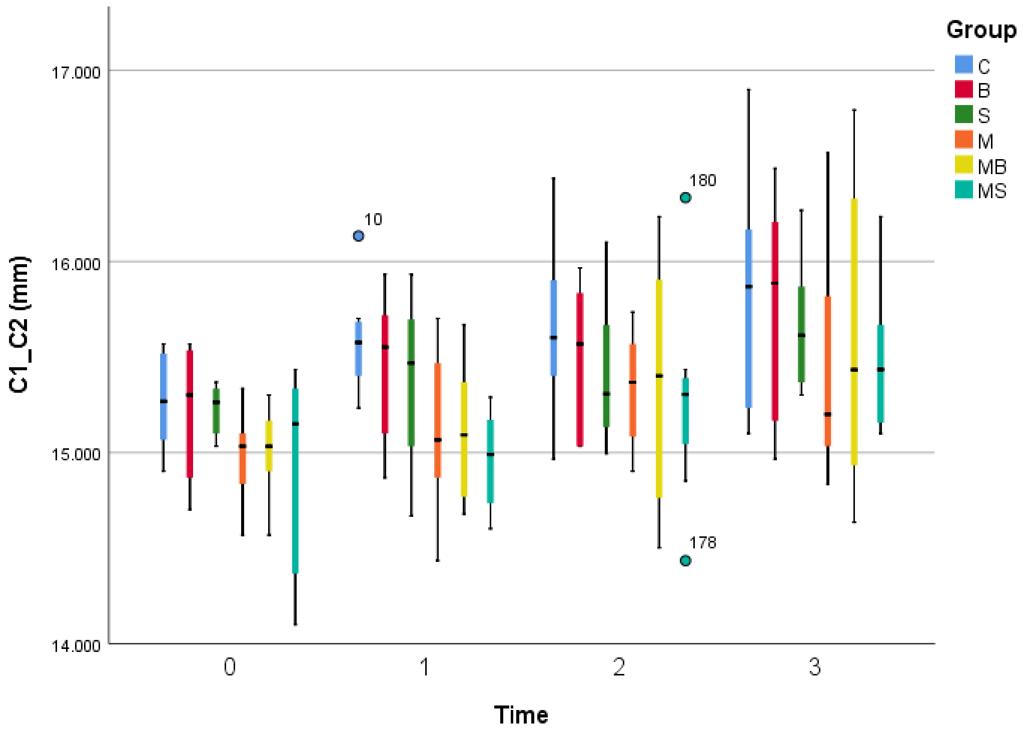


Figure 104: Mean lengths of C1↔C2 (mm) for DVC-ST groups at timepoints T0 to T3

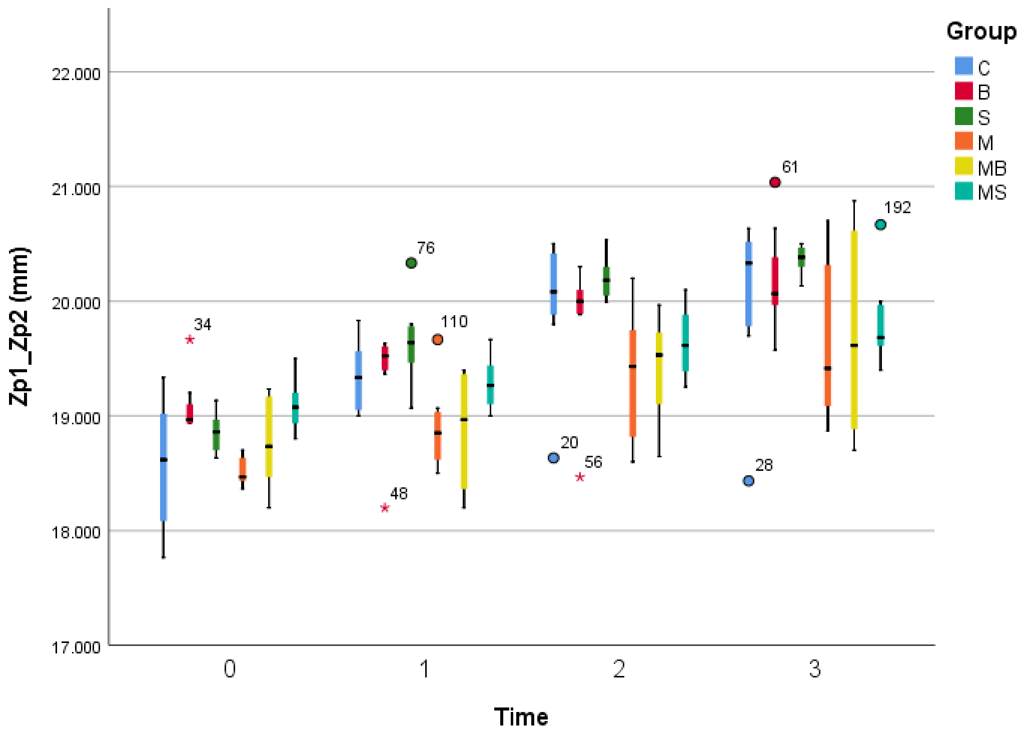


Figure 105: Mean lengths of Zp1↔Zp2 (mm) for DVC-ST groups at timepoints T0 to T3

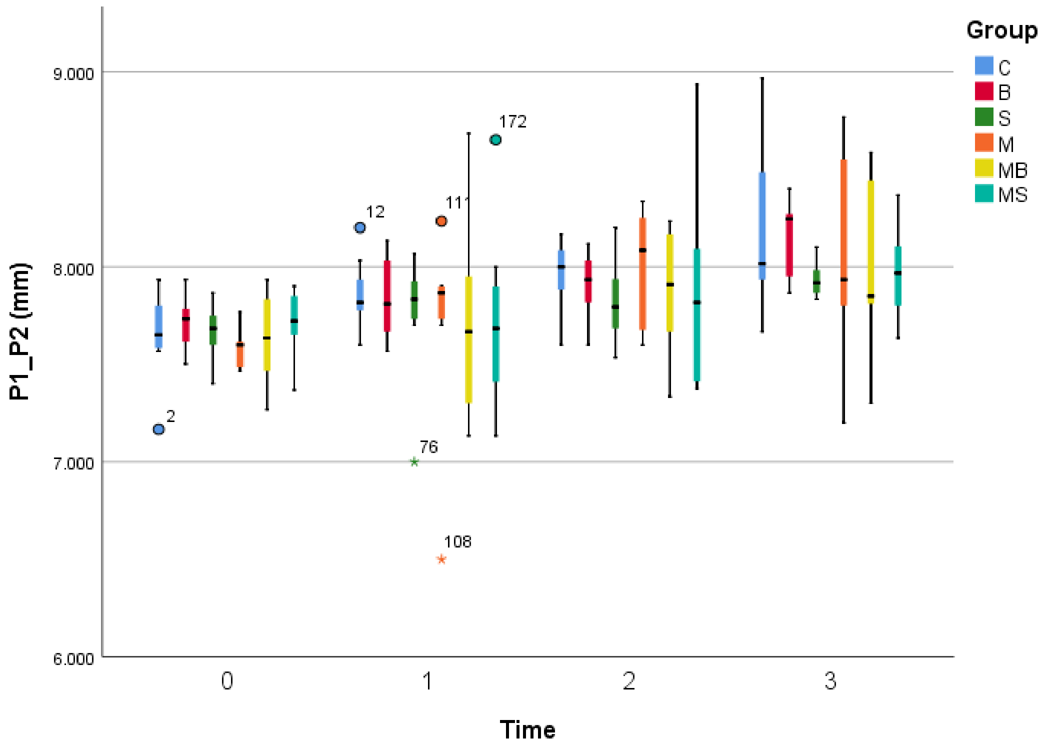


Figure 106: Boxplot of P1↔P2 (mm) for DVC-ST groups at timepoints T0 to T3

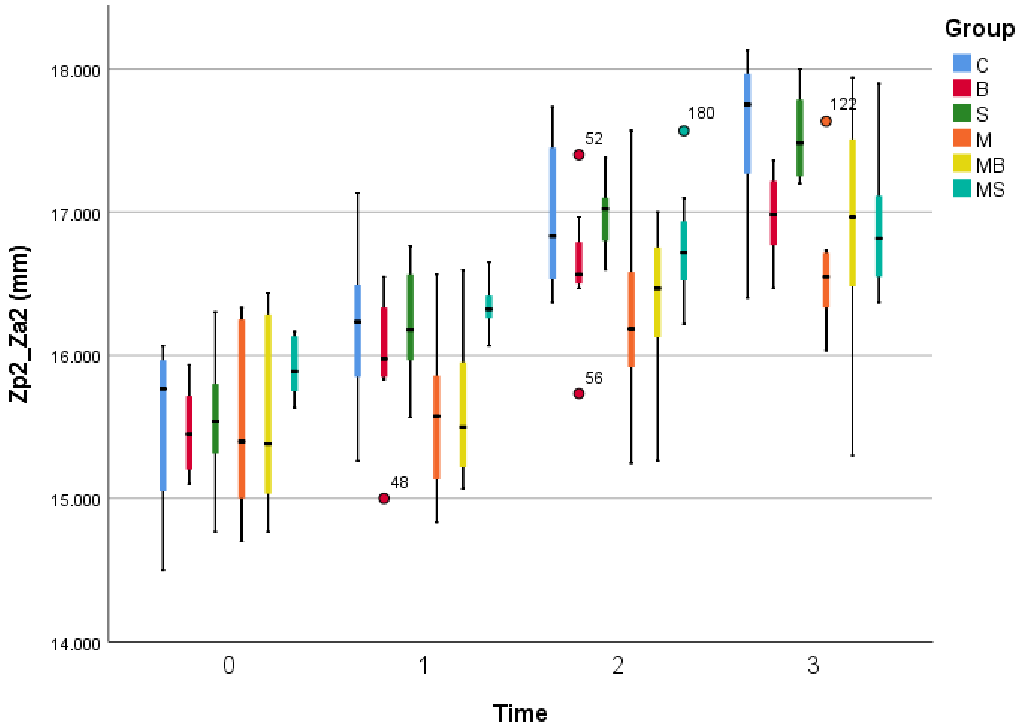


Figure 107: Boxplot of Za1↔Za2 (mm) for DVC-ST groups at timepoints T0 to T3

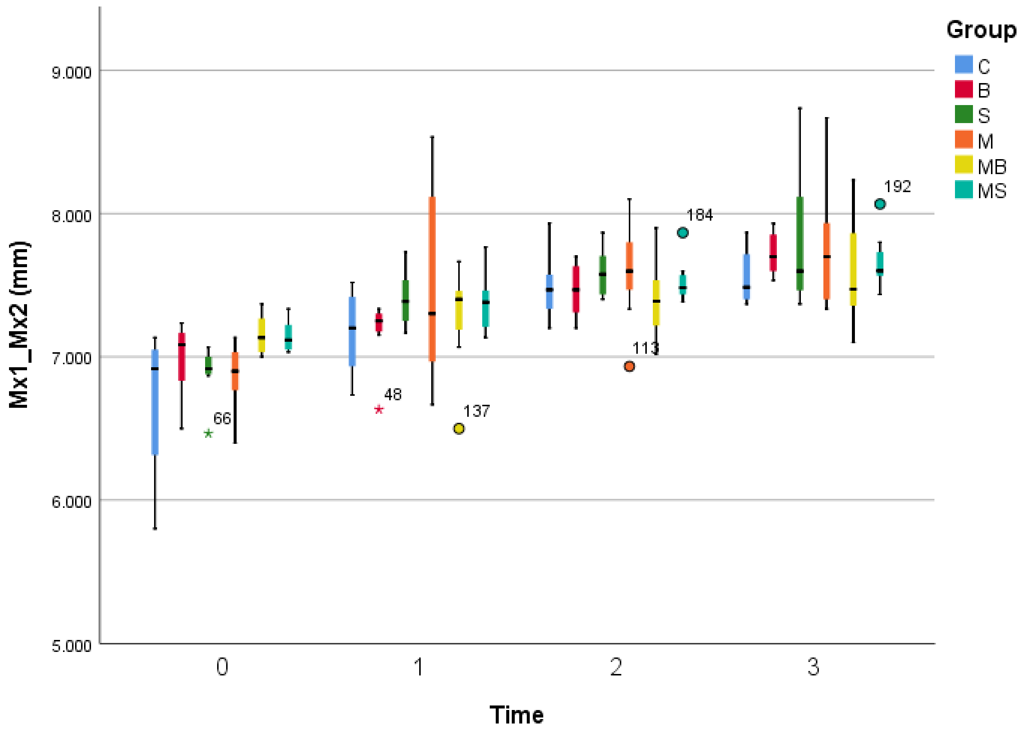


Figure 108: Boxplot of Mx1↔Mx2 (mm) for DVC-ST groups at timepoints T0 to T3

9.5.2 DVC-Long-term (LT) Boxplots

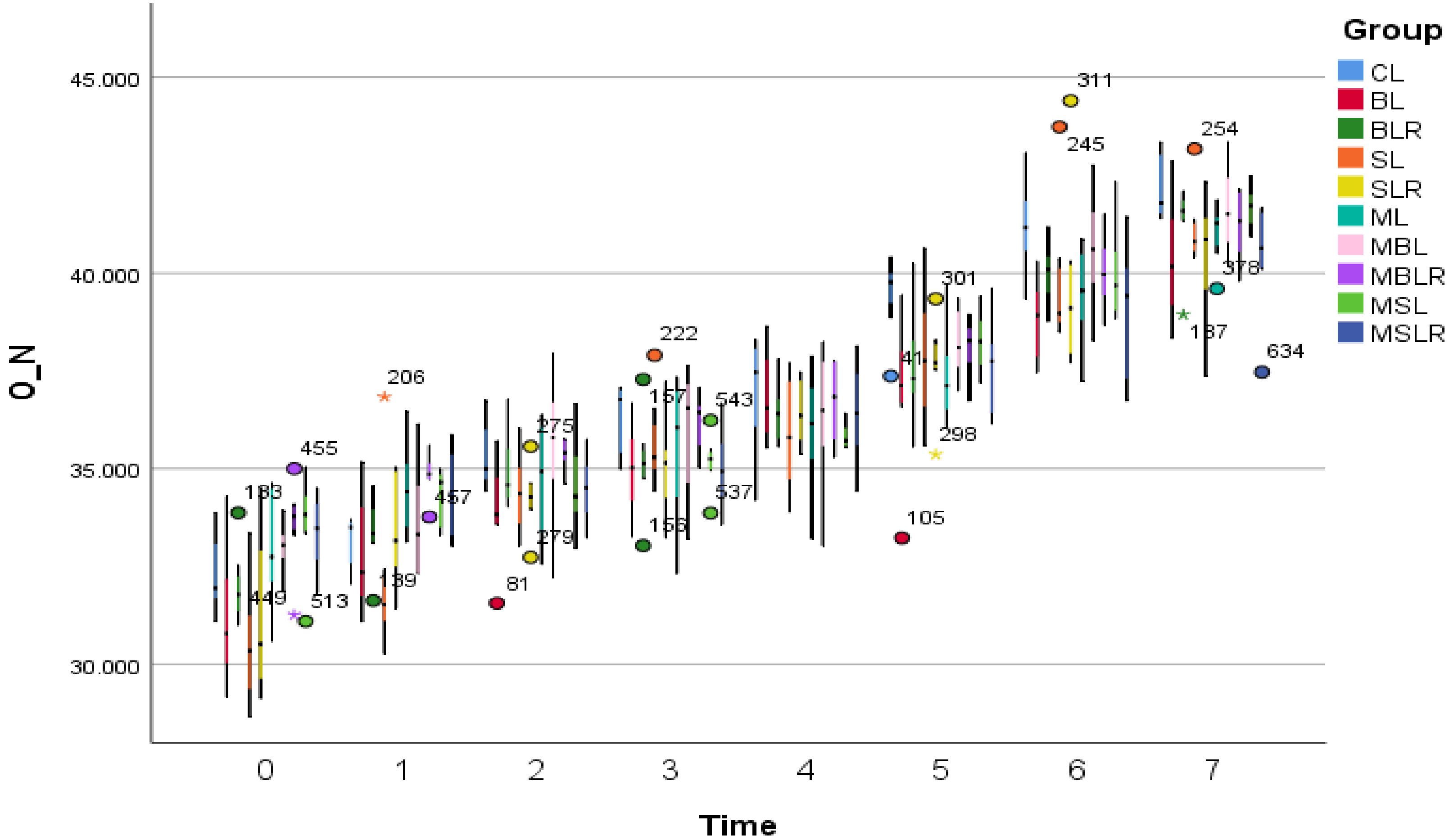


Figure 109: Boxplot of O↔N (mm) for DVC-LT groups at timepoints T0 to T7

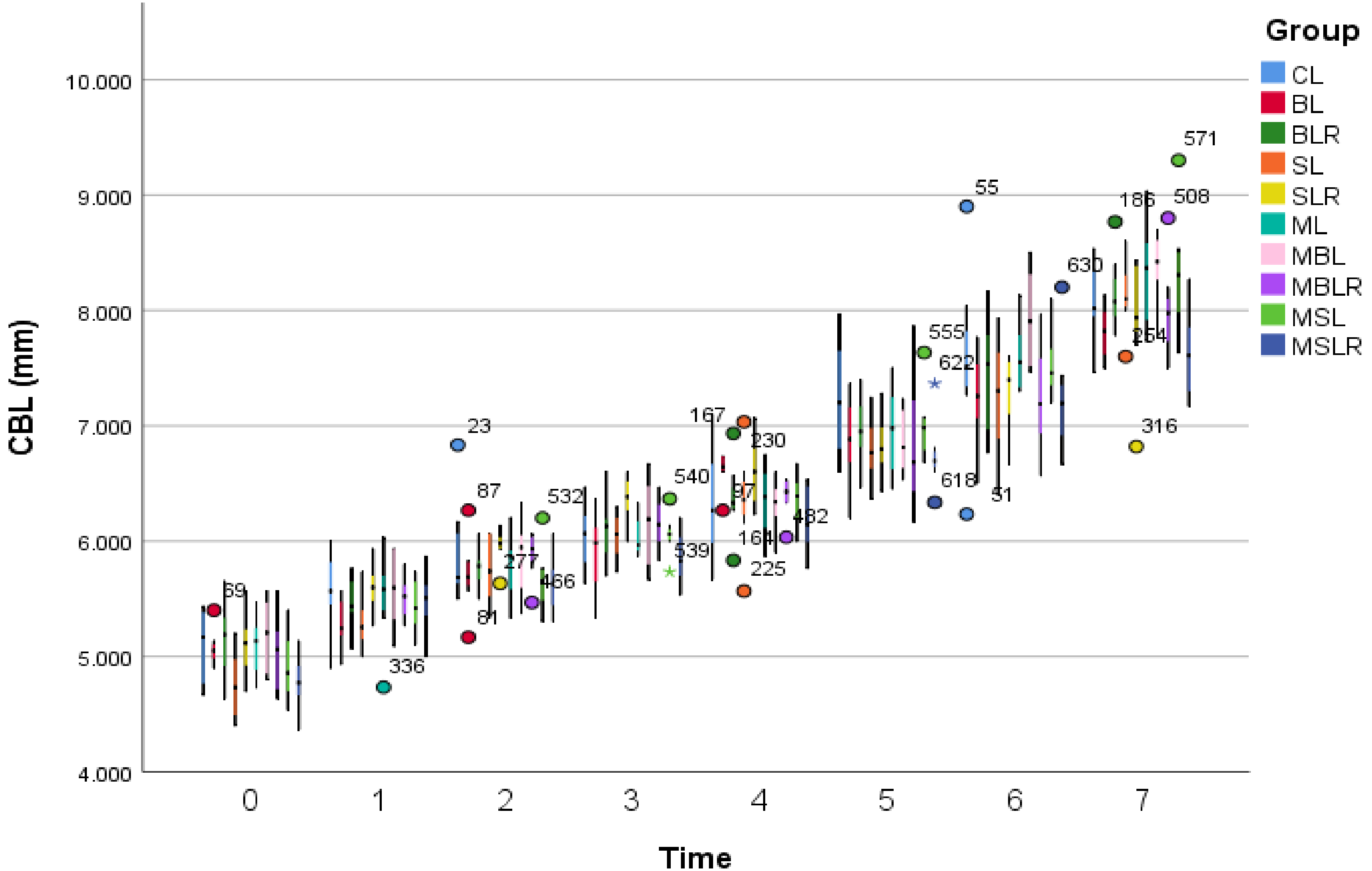


Figure 110: Boxplot of CBL (mm) for DVC-LT groups at timepoints T0 to T7

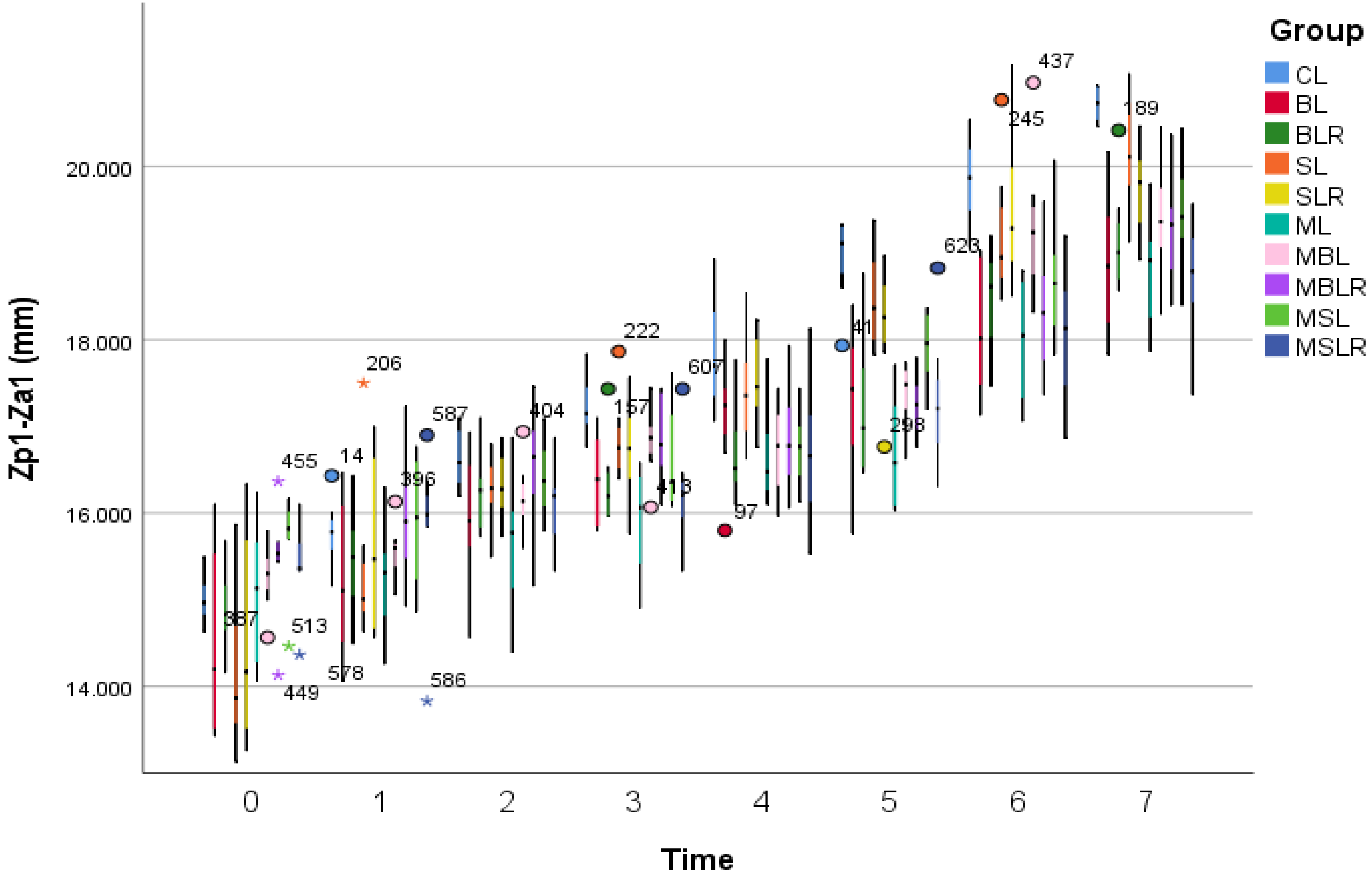


Figure 111: Boxplot of Zp1↔Za1 (mm) for DVC-LT groups at timepoints T0 to T7

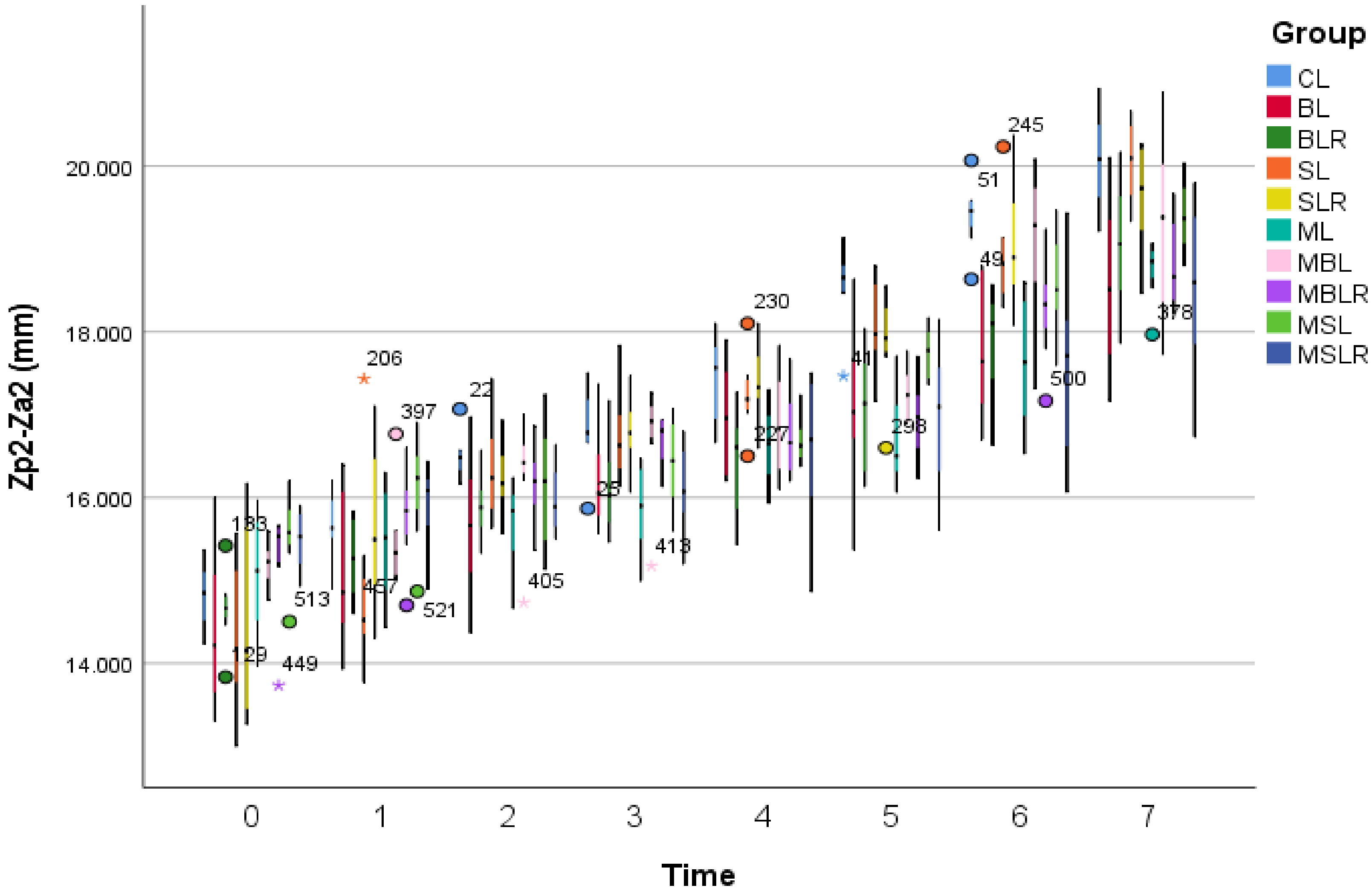


Figure 112: Boxplot of Zp2↔Za2 (mm) for DVC-LT groups at timepoints T0 to T7

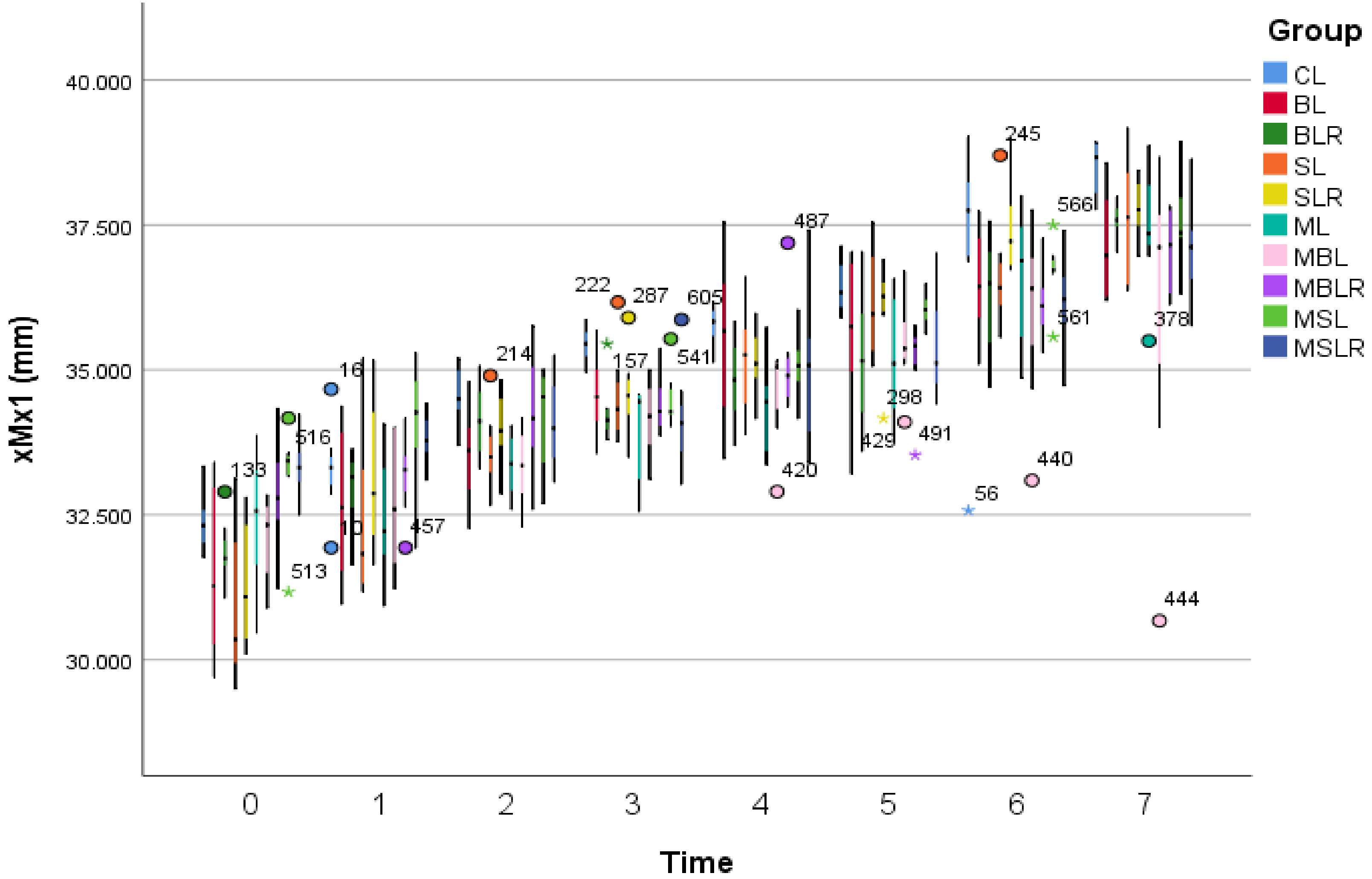


Figure 113: Boxplot of xMx1 (mm) for DVC-LT groups at timepoints T0 to T7

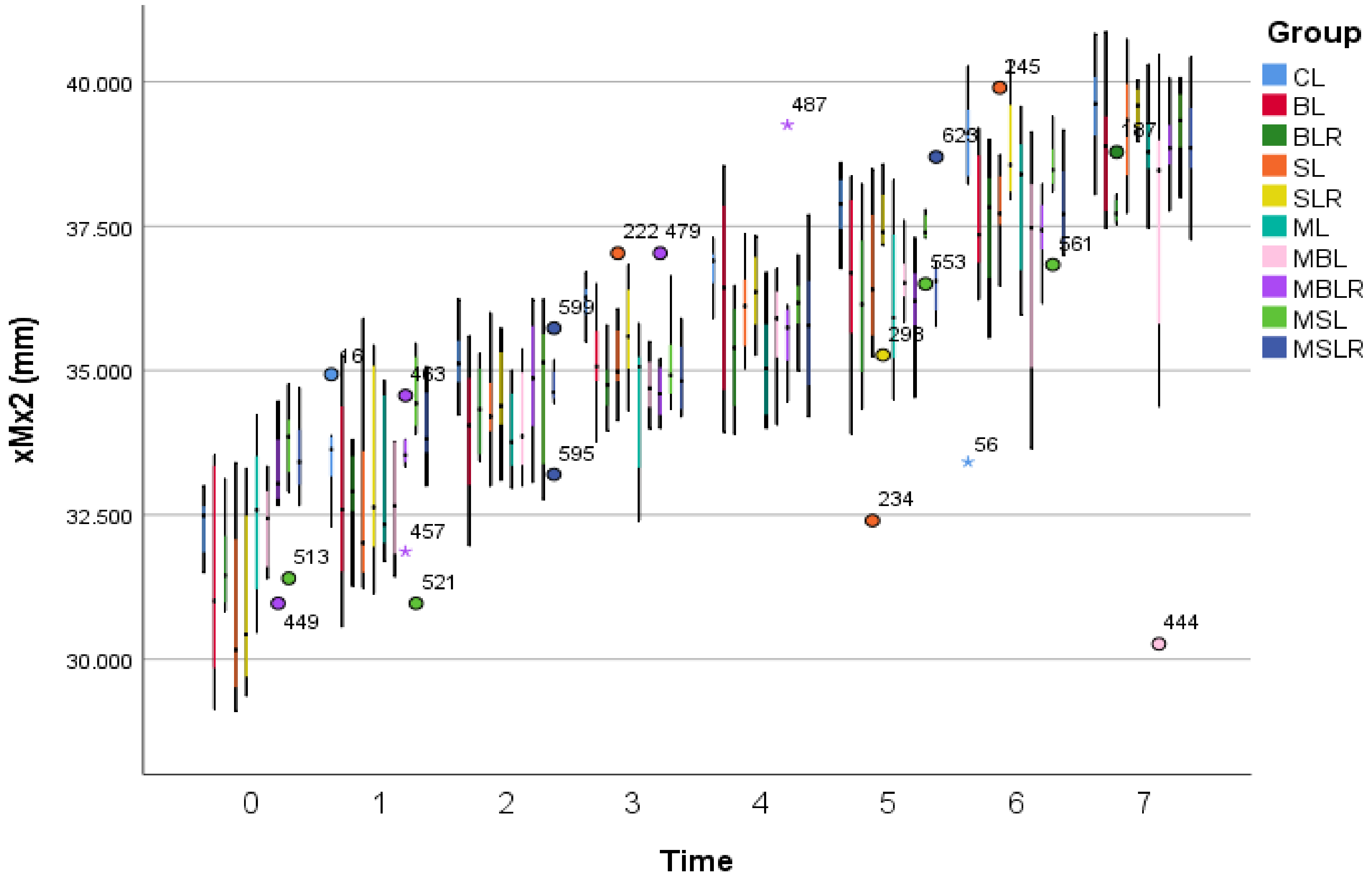


Figure 114: Boxplot of xMx2 (mm) for DVC-LT groups at timepoints T0 to T7

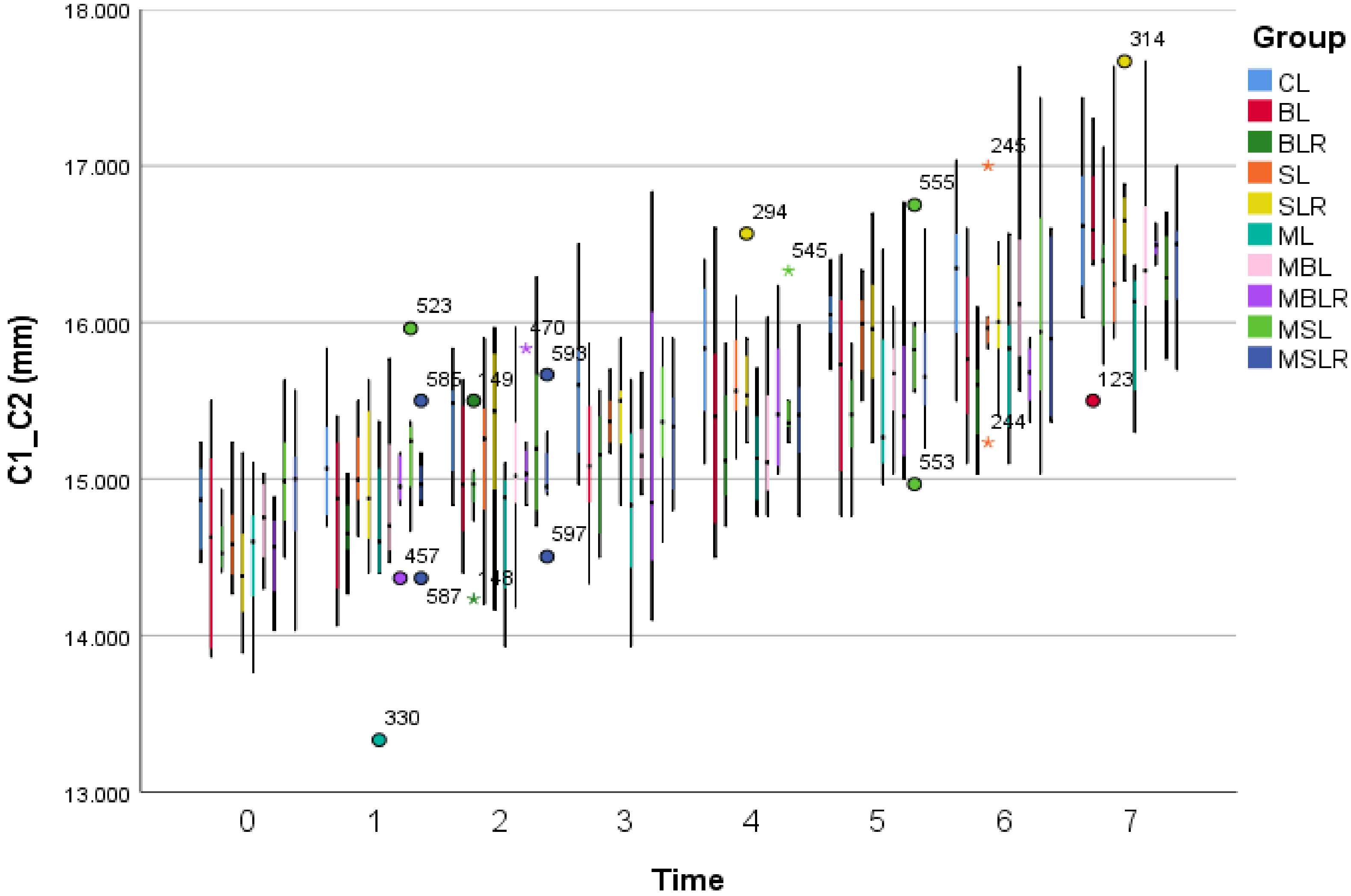


Figure 115: Boxplot of C1↔C2 (mm) DVC-LT groups at timepoints T0 to T7

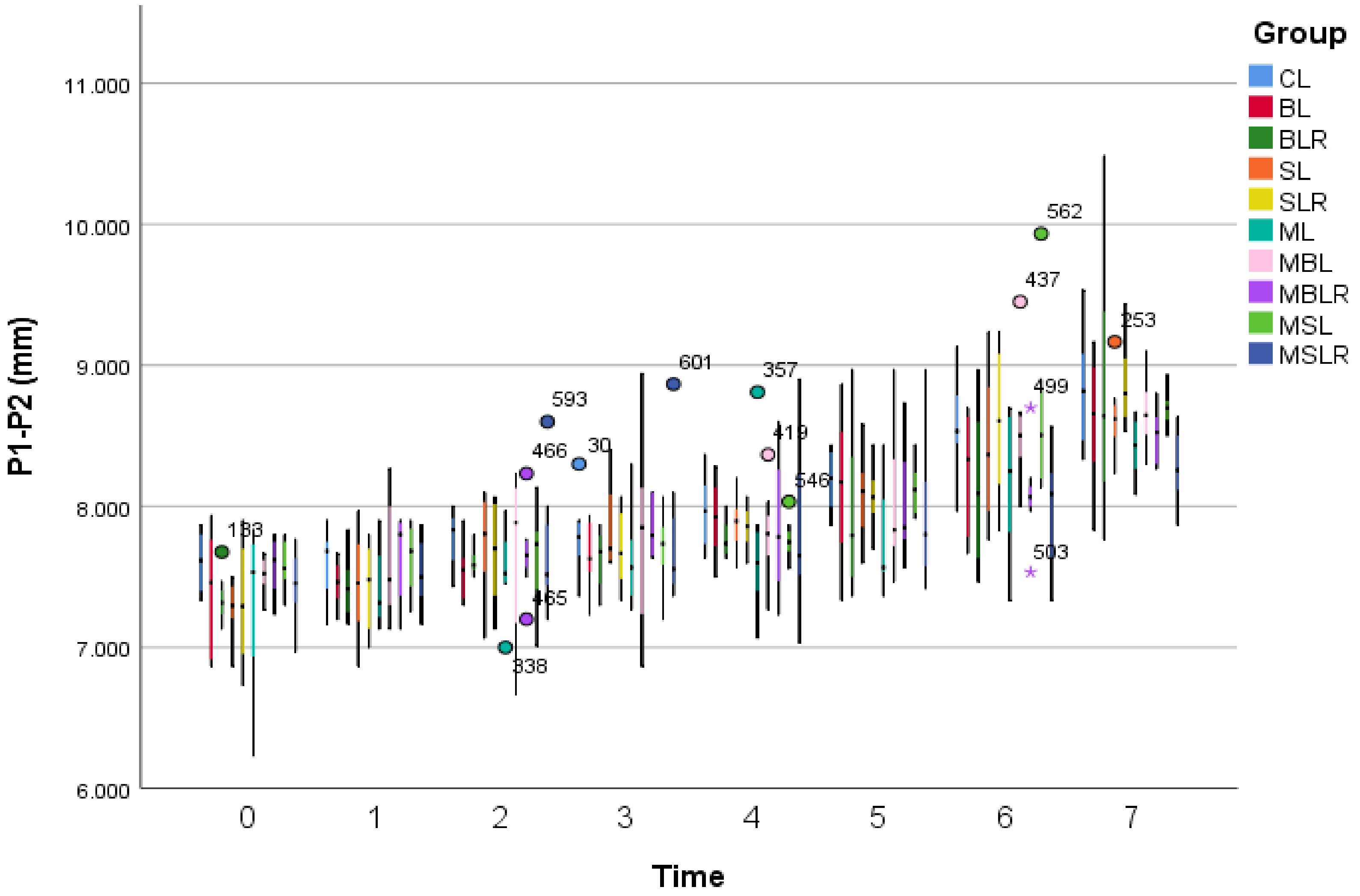


Figure 116: Boxplot of P1↔P2 (mm) DVC-LT groups at timepoints T0 to T7

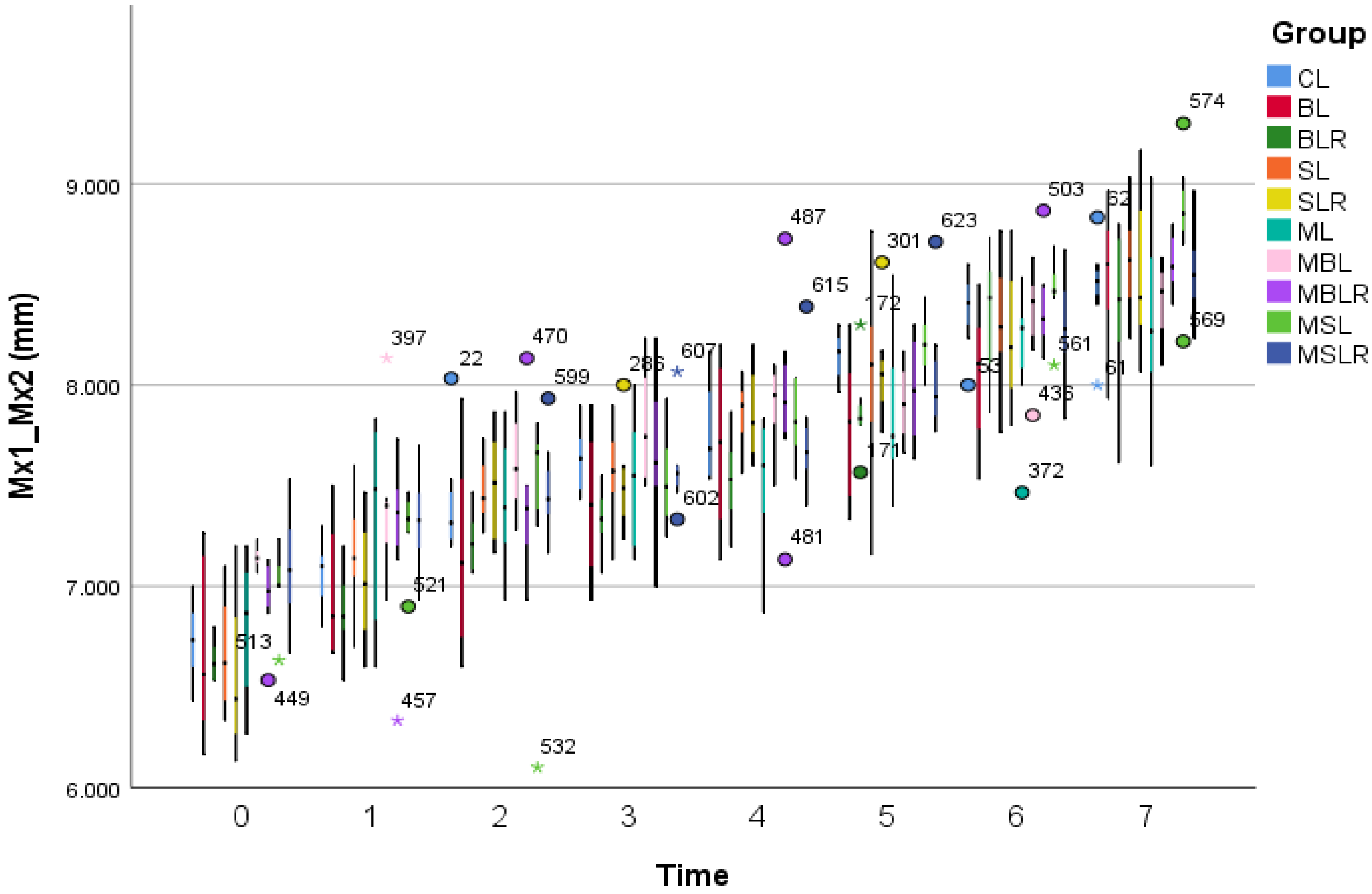


Figure 117: Boxplot of Mx1↔Mx2 (mm) DVC-LT groups at timepoints T0 to T7